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ELECTRICITY AND THE PANAMA CANAL.

The decision to use electrical machinery, as far as possible, in the construction of the Panama canal, assures us that the engineers in charge are ready to benefit by the latest methods, and that the work of excavation will be carried on as expeditiously as possible. The digging of the Panama canal seems to offer an unsurpassed opportunity for the free use of electrical machinery and electrical transmission. The work will be scattered over a comparatively long narrow strip of land, but, by means of electrical transmission, power-houses which will be economical to operate can be erected and power distributed efficiently wherever needed. The flexibility of electrical distribution, and the portability of the motors, seem to make this an ideal system for conducting such work. We have no doubt that the other advantages of a large available supply of electric power will be fully realized. In addition to electric lights, the homes, offices and hospitals may be made comfortable by electric ventilating fans, and the camps maintained in excellent sanitary condition by any of the well-known methods of disinfection.

PRACTICAL USES OF RADIUM.

Radium still maintains its position as a scientific curiosity, despite the fact that a number of useful applications of its properties have been proposed. The most important among these is its use in medicine, but such use only adds to the romance surrounding the newly discovered substance, tending rather to increase our wonder than to detract from its mystery. One scientist, however, whose mind evidently sees some practical value in everything, has made use of radium in a rather commonplace way. Botanists have a way of investigating the structure of things by embedding them in paraffin and then cutting the material into very thin sections. The act of cutting frequently electrifies the section causing them to adhere to the knife, to fold up, or to make themselves in other ways difficult to handle. This trouble has been overcome by this practical scientist by placing a small tube of a radium salt near the knife, the effect of which is to dissipate the electric charges imparted to the sections as they are cut.

Radiumized Diamonds.

Another use of radium, hardly as vulgar as the one just mentioned, is suggested in a paper read before the Royal Society by Sir William Crookes. Sir William was investigating the character of the coating which radium salts impart to diamonds exposed to their action. The surface of a diamond thus exposed for some time becomes more or less smoky. To determine the character of this action, two diamonds were secured, which, incidentally, had a pale yellow tint, technically known as "off color," an effect which decreases the value of the gem and, probably, is the reason they were selected for this experiment. One of these diamonds was exposed to a radium salt until it acquired a decidedly smoky coating. Upon removing this, it was found that the original yellow color had given way to a bluish tint, showing that radium affects not only the surface of a diamond, but in some way acts upon the whole mass of the stone. If off-color stones can be lightened in this way and the change is permanent, their value will be much enhanced, and a new field for the use of radium will have been developed. While this use is hardly scientific, it seems entirely proper that radium, the most expensive material known, should be employed to increase the value of our most precious gem. Possibly the radiumized diamonds may be put in a class by themselves. Evidently there is no immediate prospect of a decrease in the cost of radium compounds, for new uses are being devised for them more rapidly than they can be produced.

PHYSICS AND FAITH.

The rapid progress which is being made in the study of the numerous types of invisible radiations and emanations which have been described, and the discovery every little while of some new type, have put a considerable strain upon the faith and imagination of the average man. Rœntgen's discovery, which was received at first with incredulity, caused perhaps the greatest stir in the world, because it was the first time evidence of this invisible, penetrating type of radiation had been secured. Becquerel's discovery of the radiation from uranium attracted but little attention except from the scientific, but it led to the discovery of radium, which caused a sensation almost as great as that created by Rœntgen's announcement. Since then it has been shown that these radioactive phenomena are quite complicated, and that there are many substances which have this property. The novelty, except for the scientific, has worn off, and now little attention is paid to new discoveries in this field.

A New Type of Emanation.

The scientific, however, have found an entirely new field for investigation opened, and have also found opportunity for instructive controversies, not only as to the nature and cause of these radiations, but even as to the existence of certain types. When Blondlot first described that radiation which is particularly identified with his name, and which, in honor of his university, he called the N-ray, it would seem that unwittingly he had selected an exceedingly appropriate designation, for in mathematics N is used to signify an indefinite number, and M. Blondlot already claims to have identified three different forms of radiation and more will doubtless follow. The first discovery was called the N-rays, but as many physicists were unable to repeat satisfactorily the experiments which Blondlot described so carefully, the latter in repeating certain of his earlier experiments discovered the N′-rays, which, while in some way similar to the N-rays, in other respects have a directly opposite effect. M. Blondlot has now discovered a third radiation—or what is more properly called emanation, since the term "radiation" is now limited to mean either energy waves, such as light and heat, or small particles of matter shot off at exceedingly high velocities, and the new discovery seems to be either a very heavy gas or matter in some ponderable form, as it falls in a vertical direction from the body giving them off. According to the discoverer, this emanation can be deflected either by a magnet or by a body charged electrically. Air currents also produce disturbing effects, showing that resistance is met in the passage of this substance through air.

A Test of Faith.

From the frequency with which new discoveries in the field of radioactivity are made, one is led to the belief either that many things—perhaps nearly everything—is a source of radioactivity, or that the different phenomena observed are due to but a few causes, which may be somewhat removed, but which will be identified upon further investigation. In the meantime, one's imagination is being exercised, and we are being prepared for whatever wonderful discoveries may be made in the next few years. No doubt all this is excellent training for the mind, and if one's faith is balky occasionally, some comfort may be drawn from the thought that, at the present rate of progress, it will not be long before we will know much more than we do at present about these surprising things, and that a great deal of what is now cloudy and indefinite will then become clear and understandable.

DOES A TECHNICAL EDUCATION EDUCATE?

The educational value of technical school work formed the theme for the inaugural address delivered by President Charles S. Howe before the Case School of Applied Science. To examine the question satisfactorily, President Howe found it necessary first to decide upon what is understood by education. He showed that the ideas as to a liberal education differed widely with the times; but while our ideas to-day are very different from those of one hundred years ago, we still feel the influence of the old school. When knowledge was so limited that one man could acquire the whole, there was no doubt as to the meaning of a liberal education, but with the rise of science, men found many interesting fields for study, and knowledge soon became so diverse and so extensive that no one could grasp it all. Then, too, different tastes lead us in different directions. To some the study of physics appeals; others take up the science of living organism; others, again, incline toward mathematics or languages.

Each of these branches of knowledge requires for its proper study a careful preliminary training and a knowledge of certain laws and facts. The more thorough this training, the better is the preparation for special life work; yet the time which can be allowed for this preliminary work to-day is so short that we are often compelled to omit much that is desirable. We have gone one step further back, for the student to-day must specialize somewhat before he enters the university and takes up the real study of his profession or art. The education of a young man to-day, far from covering all knowledge, does not even cover all elementary knowledge. The reason is, of course, due to the demands of the student and of the country. The former feels that he should finish his education and start in to work when he is twenty-one, while the latter is constantly seeking for more help. This condition has brought about the compromise at present existing. The aim of the courses as now laid out is to turn out a man well equipped for his chosen work. That he is not liberally educated is recognized, and whatever time can be spared is given to broadening his training as much as possible. The result, it must be confessed, is not always satisfactory, due sometimes to the small amount of time which is given to this general work, and at other times to the fact that the selection is left to the student and is not always wisely made. That the technical school does not give to the man a broad educa-

tion is due to the times, and not to the schools, for nowhere else is the deficiency more thoroughly realized.

The list of subjects which President Howe thinks should be included in a liberal education is somewhat formidable. There is, however, not one of them but what is desirable. Yet it would be a difficult task to lay out a course of instruction including all of them. He holds that a man should be taught to think, to know and to search. Above all, he should be trained to speak and write his language, and this study should be followed throughout his whole school and college work. He should be taught history, particularly that of his own country, and political science and economy. He should know something about art. Chemistry and physics are both of great importance, as, in fact, are most of the sciences. The study of mathematics is not as important, although as a training for the mind it forms one of the best subjects. Just here the technical student is at a little disadvantage, because he finds it necessary to give a considerable part of his time of preparation to the study of mathematics, in order that he may later on take up the subjects of his profession which are largely based on this science.

Having laid down these requirements for a broad education, the question is raised, whether the colleges and universities educate, and it is hinted that they have gone too far in the direction of allowing too much specialization. Technical schools, having a definite object in view—that is, the training of a man for a particular profession—are utilitarian, but they give a broad education as far as they go. The first two years are given more or less to general subjects, the effort being made to teach the student to know, to think, and where to find the knowledge when he does not know it. The conclusion is thus reached, that the technical course does educate, though to a limited extent, but that it would be better if the technical graduates should first take a university course. This course might precede or follow the technical course. While all of this is desirable, there are but few young men who can—or who will admit that they can—follow such a plan. The great demand for men and the feeling that it is time for him to be out for himself both work against such an arrangement. Our school system is not perfect by any means, and if it were perfect to-day, to-morrow changes would be necessary to meet new conditions. However, it is not the colleges and technical schools alone that are at fault. In our primary schools time is wasted on matters which have little or no value as a training and which do not impart useful knowledge. Again, some things which might be useful if properly taught are taken up in a house-that-Jack-built method, which is well calculated to waste time and weary the young mind. No doubt there is room for improvement throughout our whole school system, and in making reforms it would be well to begin at the bottom. But conditions as a whole are probably no worse here than in other countries and barring a few fads, they are the outcome of the public demands and needs.

Mechanically Propelled Vehicles for Military Purposes.

The use of mechanically propelled vehicles for military purposes has been studied by Major C. E. I. McNalty, of the British Army Service Corps, who recently delivered a lecture at the Royal United Service Institution, when the subject was taken up for discussion. There are at present no mechanically propelled vehicles with guns mounted upon them in service, although a number of firms in Europe and America have constructed such vehicles. Major McNalty believes that, at the present time, motor wagons would be more useful as tractors than with the guns actually mounted upon them. Such traction engines can be separated from their loads when passing over difficult bridges; and after having placed the guns in the proper position, they can be shifted out of danger. Tractors make it possible to operate with the engines on top of a hill, in order to draw the wagons with guns on to points of advantage. The three problems now being solved, in order to increase the efficiency of the mechanical transport of guns and stores, are: increasing the radius of action; negotiating soft, greasy, steep and broken ground, and silence and absence of smoke. The advantages of the motor tractors are admitted by practically all military authorities. They are: long continuous journeys can be performed without fatigue; they are easier to move by rail or sea than horse batteries; the bulk and cost of fuel are considerably less; the weight and value of the food supply for animals, and personnel required for actual haulage, are less than where horses are used. It was pointed out that, in mounted regiments, twenty per cent of the men are usually required to look after the horses alone. Again, climatic influence has comparatively little effect on the work of motors. The length of convoys would be reduced, with a corresponding decrease in the strength of the escort, and when the enemy was likely to capture wagons, it becomes a simpler matter to render the engine useless. The wastage will be less than with animals. During the South African campaign 160,000 horses were lost. The great disadvantage is that a single shot might disable the engine, leaving the whole train out of gear. Major McNalty thought that for some time, at least, the chief use of tractors would be in moving guns and stores across country; and that after reaching the desired position, the guns would be taken into action by horses, as this can be done more expeditiously.—*Engineering* (*London*), July 8.

Electric Bus Line.

Workmen are now placing poles on the Loudonville road for the operation of an electric bus line from Latham's Corners to Albany. The poles are now in position from Latham's Corners to Canton's Hotel, and it is confidently predicted that the road will be in operation by the first of September. The Schenectady Railway Company originally intended to construct a trolley line through this district and the poles, rails and ties have lain on the roadside for the past two years. They have been recently removed, however.

The buses will be run over the Loudonville road as far as the Shaker road, and will then be run over the latter road into North Albany, connecting with the United Traction Company's lines at this point. The successful operation of this line will mean probably that many others will be instituted in the vicinity where it has been found that it would be unprofitable to operate a trolley line.

There are thirty-five municipalities in Ontario which own their own electric lighting plants.

The Action of Light Upon the Formation of Accumulators.

This is a communication from M. D. Tommasi, in answer to several criticisms of a preceding communication, of which a note has been made. One writer claims that the phenomenon alluded to had been observed by him some years previously. His method of experimenting was to expose a plate of lead, oxidized by the Planté method, to the action of light, and to watch the effects. This experiment, according to the author, is entirely different from that which he had described, as it was limited merely to the action of light upon lead oxide. His work was upon the effect of light and darkness upon the formation of positive and negative plates. M. Tommasi has also investigated the effect of light from different parts of the spectrum, upon the sub-chloride of silver. He finds that the red rays deepen the color of the sub-chloride. The yellow rays have the same effect, but not as pronounced. The green rays bleach the sub-chloride strongly. The blue rays have a bleaching effect as strong as that of ordinary light, the violet rays having but a slight bleaching effect. The same effect would be obtained if a plate of lead, covered with lead peroxide, were exposed to the different rays in the solar spectrum.—*L'Electricien (Paris), July 9.*

The Turbine and the Engine.

To the Editor of the Electrical Review:

In a modern power station where everything was new,
The Engine and the Turbine laid their futures in review.
The Engine was not hopeful of events that it foresaw—
Thought the Turbine would outclass him in this commercial war;
But the Turbine was elated, tried to cheer the engine up.
Told how glory, use and power had filled his spacious cup,
And while the future of the Turbine was a broad and useful field,
There were conditions under which the Engine need not yield.
The turbine said his quick rotation, and the power that he commands,
And his few and simple parts, would place him in demand;
The modesty of space he needs where ere he is installed,
Is a feature that attracts, but the Engine feels appalled.
His smooth and noiseless running gave the Engine deep despair,
To say nothing of improvements that are whispered in the air.
His efficiency, he said, would pass the Engine very soon,
And at his cost of operation, he feels as placid as the moon.
Feed him on superheated steam, with a vacuum rather high,
For that's his strawberry shortcake and New England pumpkin pie.

F. A. Barron.

Schenectady, N. Y., July 18.

Test of an Electrical Towing Machine.

On Wednesday morning, July 20, a test was made of an electrical towing apparatus on the Erie canal, at Schenectady, N. Y. Thirty-five hundred feet of rail had been laid down on the tow-path, opposite the works of the General Electric Company, and six loaded canal boats, with a total weight of about 2,800 tons, were pulled at a speed of over four miles an hour. The inventor of the towing apparatus, Mr. Stephen W. Wood, regarded the experiment as extremely satisfactory. The patents on the system are owned by the International Towing and Power Company, Schenectady, N. Y. The test was watched by a number of prominent engineers, and among these were several representatives of the General Electric Company.

The Armour Institute of Technology.

The year book for 1904-1905 of the Armour Institute of Technology, Chicago, Ill., has been received. This contains descriptions of the various courses offered at that institution, and of the equipment available for this work. Courses are now offered in mechanical, electrical, civil, chemical, fire-protection engineering, and in agriculture. Courses are also offered in general science. The institution has made arrangements to undertake commercial tests for the public, its equipment being available for this purpose.

The book contains a list of the faculty and a diagram of the mechanical engineering laboratories. The secretary of Armour Institute of Technology is Mr. Frederick U. Smith.

The Society for the Promotion of Engineering Education.

The next meeting of the Society for the Promotion of Engineering Education will be held at St. Louis, Mo., September 1, 2 and 3. The sessions will be held in the Education Building at the St. Louis Exposition. In addition to the address of the president, papers are promised from John Findlay Wallace, chief engineer of the Panama Canal Commission; Alfred E. Burton, Ira N. Hollis, Henry S. Monroe, Edward E. Maurer, Leander M. Hoskins, Anson Marston, Alfred Kenyon, Benjamin F. Groat, Emery H. Powell, John G. Mack and Alexander C. Humphreys. Reports will be submitted by the five standing committees, and from a special committee.

Comparative Tests of Illuminants.

The Schuckert Electric Company, of Nuremberg, made some time ago comparative tests of incandescent gas and electric arc lights, the results of which, says the *Scientific American*, have just come to hand. These experiments, carried out by Dr. Lehmann Richter, gave the following results: The surface luminous intensity at the level of the eye proved fully satisfactory for both light sources, the arc light affording also a uniform distribution of light. In the case of the electric arc light, no noxious alteration of the air was noted, the temperature would not rise to any appreciable extent, nor would the percentage of carbonic acid be augmented. With incandescent gas light, on the other hand, the temperature at the level of the eye was found to rise by about six degrees centigrade in the course of three hours, while the percentage of carbonic acid was found to increase to more than five times the initial figure. As regards the cost of operation of both classes of light, this proved somewhat smaller in the beginning with the Auer light, whereas, after a short time, the figure corresponding to the cost of operation of the arc light was reached, even without taking the lighting flame into account. When accounting for the lighting flame, on the other hand, the cost of the Auer light would be much higher than that of the electric arc light.

The Ohio Electric Light Association.

The annual meeting of the Ohio Electric Light Association will be held at Sandusky, Ohio, August 16, 17 and 18. It is expected that a complete programme will be ready for announcement at an early date, and the great success which has attended all the previous meetings of this association bids fair at the present time to be at least equaled.

Washington, D. C., Electrical Contractors Meet.

The Electrical Contractors' Association, of Washington, D. C., on July 20 elected the following officers: D. M. Anderson, president; Cyrus Mantz, vice-president; H. R. Carroll, secretary; R. F. Metzel, treasurer.

Electricity in Grand Trunk Tunnel.

It has been announced that the St. Clair Tunnel Company had decided to abolish steam power and adapt electricity for moving trains through the Grand Trunk tunnel under the St. Clair river. A third-rail system will be installed at a cost of $400,000.

TELEPHONE ENGINEERING—VIII.

BY J. C. KELSEY.

THE TWO-STRAND DOUBLE-BATTERY REPEATING-COIL SYSTEM.

The common battery systems discussed in preceding chapters are used exclusively by the licensee companies of the American Telephone and Telegraph Company. Their individuality, for one part, is characterized by the general usage of three conductors or strands in the cord, jack and plug, and are termed tip, ring and sleeve. Associated with the sleeve are many of the necessary functions of a multiple system. It serves as a busy test terminal, as a means for lighting the supervisory lamps and as a means for operating the cut-off relay. Common battery systems necessarily have supervisory lamps, to be lighted when the plug is inserted, and to be extinguished when the plug is withdrawn. If the lamps were lighted permanently, a great waste of current would result. For this purpose the inventors used the third, or sleeve strand, so that when the sleeve of the plug came into contact with the jack sleeve, the supervisory lamp was rendered operative. The plug switch realizes the same purpose, though much inferior in operation. Therefore, when the competing telephone manufacturer came into the field, he was confronted with the possibility of infringement suits if he attempted to use the sleeve or third strand for lighting the supervisory lamps, or using the jack sleeve as a test terminal.

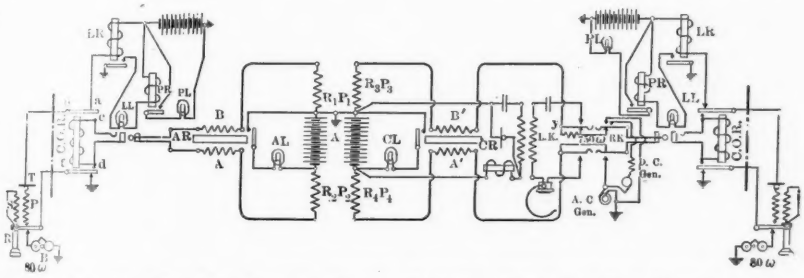


FIG. 14.—THE TWO-STRAND, DOUBLE BATTERY, REPEATING-COIL SYSTEM.

This two-strand system using two batteries of equal pressure, each twenty volts, is distinctly original, as applied to common battery, and may be said to characterize the independent practice, at least the two-strand feature is. While this system was developed, with possibly a view of avoiding infringement, a greater purpose was in the mind of the inventor. That purpose was to reduce the cost, as well as to effect a saving of space. The average 5,000-line board of the licensee companies, including trunk sections, there are approximately 110,000 jacks, 60,000 feet of sixty-three wire cable and 1,800 cords and plugs. Rating jacks at twenty-five cents and cable at twelve cents a foot, the cost of the three-strand multiple would be about $35,000, or nearly one-third of the entire cost, which is $100,000. If a two-strand system is used, the jacks could be rated at eighteen cents and the cable at seven cents a foot, or the cost of the multiple to be $24,000. A saving of $11,000 in the multiple, besides the cords, plugs and other auxiliaries, which goes to place the 5,000-line board in the hands of the independent operator for $80,000. While this is a digression and subject to criticism, it will serve to illustrate the point that the state of competition is at all times a factor in design.

The sleeve strand serves as a test terminal, as a circuit for the supervisory lamps and corresponding cut-off relays. Around this sleeve, or third strand, hinges the successful operation of a multiple system. The two-strand system finds all these points necessary. It has to have a test terminal. It has to operate its cut-off relays upon the entrance of the plug. It has to cause the supervisory lamps to light upon the entrance of the plug into a jack. The talking circuit requires two strands, for metallic service is absolutely necessary. Therefore, all these functions are concerned with the talking circuit. One side of the talking circuit must necessarily serve as a test terminal. The talking circuit will be involved when the operator plugs in, thereby lighting the supervisory lamps and operating the cut-off relay. A talking circuit necessitates a freedom from grounds, impedances and the like. The talking circuit must be balanced and quietly connect two talking subscribers.

The accomplishment of this purpose was happily solved by Mr. Dunbar, of the Kellogg Switchboard and Supply Company.

In Fig. 14, the subscriber's instruments are shown, in which T is the transmitter, P the primary, S the secondary, R the receiver and B the low-resistance ringer. The connection of this ringer resembles the connection of the series grounded instrument as the ringer is cut out of the circuit during conversation. But this grounded ringer serves a greater purpose than simply calling the subscriber, and then being cut out of the circuit. This point governs the action of the supervisory relays. When the receiver is removed from the hook, the line is made fully metallic, and thereby made quiet for talking purposes. The ringer B is connected to ground from the lower contact of the receiver hook, from the sleeve, or second talking strand of the circuit. The tip side of the line is open at the instrument, and closed at office through the contact *a* of the cut-off relay COR, the line relay LR and the battery A.

Calling central is accomplished by the removal of the receiver from the hook. It closes the battery through a metallic circuit, composed of line relay LR, contact *a* on the cut-out relay, the transmitter T, the primary P, over the sleeve side of the line to battery ground G. This causes the relay LR to be energized, to pull up its contacts and cause the line lamp LL to light. As all the current for the panel of line lamps has to pass through the winding of a pilot relay, the relay PR will also be energized and cause the pilot lamp PL to light. If the night bell switch is open, the current through the pilot lamp will energize the night bell relay and cause the night bell to ring.

The act of plugging into the jack corresponding to the lighted lamp causes the line lamp to be extinguished, because the relay COR is actuated by the entrance of the plug, which disassociates relay LR from the circuit. This is accomplished by battery flowing from the battery over both sides of the talking circuit of the answering cord, through points *c* and *d* into the winding of COR, energizing it, opening line at points *a* and *b*.

The same process that opens the line relay circuit has another very important function. It brings the multiple and answering jack terminals into use. Normally, they are disassociated from the circuit. The energization of COR brings line terminals *e* and *f* into contact with the jack terminals at *c* and *d*, so that the talking circuit will be closed through the answering cord.

The darkening of the supervisory lamp occurs upon plugging in, because the subscriber's receiver is off the hook. However, the entrance of the plug has caused the supervisory lamp to be in a position

to light up when the receiver is replaced on the hook.

This is accomplished by means of a cord relay AR. This relay, being in the talking circuit, is necessarily non-inductive. This is done by two windings, differential, in operation, of equal number of turns and resistance and equally disposed on the core. If the windings were placed on each end of the core, the differential effect would not be entirely non-inductive, for the reason that each winding would set up lines of force in its respective end of the core. These lines of force will neutralize each other, but on account of inevitable leakage, some of the magnetic energy would be lost. Hence, the coil is not non-inductive, and will be detrimental to voice currents. If the windings were concentric in nature, each coil wound over the whole length of the core, or each wire wound side by side, there would be no lines of force set up in the core, because the neutralization takes place between the wires themselves and preventing magnetic energy altogether.

When the operator plugged in to answer the call, the battery current flows through the winding A, of AR, through contact *d*, relay COR, contact *c*, winding B, of AR, back to the battery. The current also divided at points *c* and *d* and passed through the instrument transmitter and primary. But the same amount of current that passed through winding A passed through winding B, on its way back, so to speak, thereby neutralizing the relay. As the relay is of the make type, the neutralization of the relay prevents any current from passing through the lamp AL.

Should the subscriber become impatient and raise and lower his receiver hook, he changes the conditions in windings A and B. Hanging up the receiver or pulling the hook down with the finger, puts a ground on the sleeve side of the line at the instrument. Then the current flows from battery through winding A, contact *d*, relay COR, contact *c*, winding B to battery, but not in equal amounts, for some of the current passes out on the line through contact *d* to ground and back to the battery without passing through winding B. Winding A is stronger than winding B, therefore the armature is attracted and lamp AL is lighted.

As relay AR is non-inductive, it will not serve to individualize the circuit, that is, cause it to be free from cross-talk, hence the necessity of a device which will. A repeating coil is necessary to repeat the fluctuations of the voice currents from one subscriber to the other, because two distinct batteries are used. The calling party gets his energy from the A battery and the answering party uses the B battery. The repeating coil windings will individualize the circuits, hence the winding R_1P_1 is placed on the tip side, and the winding R_2P_2 on the sleeve side, with battery A between.

The operator answers the call by throwing the key LK. This places her telephone across the line. The customary condenser is placed in the secondary circuit to prevent the battery click, and confusion of signals. She is only in inductive relation with the calling subscriber, as the windings of the repeating coil separate them, R_3P_3 and R_4P_4 being connected to the calling cord, with tip and sleeve respectively.

Finding the number desired, she makes a test in the usual manner by touching the tip of the calling plug to the test terminal of the desired number. Touching the tip to a busy jack causes the battery, which exists on the sleeve, to flow back to the ground through the winding B, of CR, and the repeating coil winding R_3P_3. This stores up energy in the core of the repeating coil, which, when the plug is removed from contact with the sleeve, shows itself in the form of a click in the bridged receiver and in the bridged subscriber's instrument. So far this is well enough for the testing operator. The test is a natural one, not too loud nor disagreeable. But the subscribers talking, upon whom the busy test is made, get a forcible reminder of the test. Being a two-strand system, one side of the talking circuit is a test terminal. Touching the tip of the calling plug to the sleeve of the busy jack, simply robs the subscriber of the proper amount of current. The reduction of the current in the subscriber circuit is accompanied by a severe receiver click. After being subjected to several test clicks, the subscriber would be seriously annoyed. In the three-strand system, the touching of the tip to the sleeve only reduces the current flow through the cut-off relay, but the talking circuit is not affected. Therefore, if this system is to have a busy test, some alteration will have to be made. This alteration consisted of the use of a 700-ohm coil, connected at the points *x* and *y* in such a manner that when the operator threw open the key LK to make a test, the current from the talking circuit was but slightly weakened by the ground through 700 ohms, the winding B, of about thirty-five ohms, and winding of the repeating coil R_3P_3. With this method, the talking subscribers were but fairly aware of a test being made.

One objection can be made to this method of inserting the 700-ohm resistance. That is, should the operator listen in on a conversation she would throw the 700 ohms in series with the talking circuit and separate the talkers. But with supervisory signals, the operator has no business listening on connections. Hence, no objection can be reasonably taken. When the operator finds the line desired in disuse, she inserts the plug, which causes the current to flow from battery B through R_4P_4, winding A', sleeve of plug and jack, through relay COR, through tip of plug and jack back through B' and R_3P_3. This actuates cut-off relay COR and also relay CR, because the ground at the called subscriber's instrument causes more current to flow through winding A' than winding B', causing it to attract its armature, and close battery circuit through the lamp CL.

The ringing of the called party in the three-strand system caused no complications, as the third strand was not in any way concerned with the generator current. But with the two-strand system, the jack terminals are normally disconnected, and are only in connection with the line, when the plug is inserted, which allows battery to flow through the cut-off relay. But the ringing key is connected with the cord circuit, and it is necessary to open the circuit during the ringing to prevent the short-circuiting action of the battery, besides ringing back in the subscriber's receiver. The act of ringing then will open the battery supply to the cut-off relay, which would be deenergized and open up the jack terminals, so that the ringing current could not be conveyed to the subscriber's ringers. Some means for temporarily holding this cut-off relay in operative position must be provided during the act of ringing. This is done by means of two generators, one delivering alternating current and the other direct or pulsating current. The direct-current generator has an impedance in series with it, so as to prevent the short-circuiting of the alternating generator. The operation of the key RK puts two kinds of current on the circuit. The alternating current rings the subscriber's bell, while the direct current holds the cut-off relay. The release of the ringing key restores battery to the cut-off relay.

The extra direct-current generator was

dispensed with, and the contact *r* at the tip ringing spring was connected to the battery through an impedance. The alternating generator was connected directly to the opposite spring. The act of ringing caused the main battery to pass through the impedance, through the cut-off relay, and to ground through the armature of the alternating generator. The alternating current was prevented from flowing through the cut-off relay back to battery by the impedance placed in the circuit.

When the subscriber removes his receiver the relay CR releases its armature and extinguishes CL, because the removal of the ground at the subscriber's instrument has caused equal amounts of current to pass through the differential relay CR.

Both parties are talking and both lamps are darkened. When the calling party hangs up AL lights. When the called party hangs up lamp CL lights. Whereupon the operator pulls down the connection.

The Use of Briquettes by French Railroads.

United States Consul John C. Covert writes from Lyons, France, under date of June 8, that the inspector-general of the Paris, Lyons & Mediterranean Railroad Company has announced that his road uses large quantities of coal briquettes, about ten per cent of its fuel consisting of this material. In this manner the road is enabled to use all the slack and coal dust from the mines. The engineers can get up steam more quickly with briquettes than with any kind of coal without them. They form no slag or clinkers, and tend to prevent the formation of clinkers when used with other coal. The company manufactures its own briquettes. About sixty-five per cent of its fuel consists of fine coal or slack.

The American consul announces that a fine specimen of "coaleo," a form of briquette manufactured in St. Louis, Mo., has been received at Lyons and is attracting a good deal of attention. Coal briquettes are in very general use in France, hardly a house being without them during cold weather. They are more easily handled and more readily ignited, and also throw out more heat than coal, and make no dust.

Proposed Memorial to Gramme.

Efforts are being made in Europe to raise a fund by means of subscriptions, which will be used in erecting a memorial to the late Zenobe Gramme, the inventor of the Gramme dynamo. M. Ernest Gerard, 25 Avenue des Arts, Brussels, will accept all donations.

Electricity in Plant Life.

A most interesting project is being considered by the scientific section of the British Royal Horticultural Society. As soon as the necessary funds can be raised it is proposed to establish at the new gardens at Wisely, near Weybridge, a scientific station or botanical laboratory, and one of the special studies to be undertaken will be the growth of plants by electric light as a substitute for sunshine. To be independent of the gloomy English climate, and to produce the most beautiful flowers, and even ripen strawberries and other delicious fruits in winter, is one of the gardener's most cherished dreams. The fact that artificial light will enable plants to grow and fruits to ripen has long been known to scientists. More than forty years ago M. Hervé Mangon found that the electric rays would enable plants to form the green chlorophyl or coloring matter of their leaves, and that flowers turned toward the electric lamp just as they turn toward the sun.

In 1879 and 1880 the late Sir William Siemens made some remarkable experiments at Tunbridge Wells, the results of which he showed to the Royal Society. By supplementing the sunlight of day with electric lamps at night, both in the open air and in greenhouses, he caused roses and arums to bloom long before their usual time, melons and cucumbers, vines and strawberries also responding most gratefully to the stimulus of the added light. The sunlight of millions of years ago, stored up in plants which afterward became coal, was thus disinterred and made to do its work over again in ripening fruits and causing flowers to bloom. Although electricity then cost three times as much as now, Dr. Siemens, as he then was, was enthusiastically convinced of the value of the electric light for the garden.

As usual, there were many objectors to the new proposal. A sort of humanitarian outcry was started on behalf of the poor plants themselves. To make them grow night and day would give them no rest. They would be old and exhausted before their time, and would perish miserably as the result of their artificial mode of life. Experience since then has shown, however, that the plant does not need rest, like an animal. In Norway, Sweden and Finland, during the short two months of summer, while the sun never goes down, vegetation flourishes with astounding luxuriance and rapidity. Flowers take on the most gorgeous colors and have exquisite perfumes, vegetables grow like magic, and then comes the long winter, and they have a correspondingly long rest.

An even stronger illustration of the power of plants to do without a nightly rest is the great natural gas fire, a steeple of flame, which has burned for generations in the Pittsburg district in this country. All round and just outside the circle of its scorching heat is a ring of tropical vegetation, which the warmth and light have produced, the plants seeming all the richer and more luxuriant for living in a blaze of light night and day alike. Even if plants were really exhausted by artificial light, we grow them not for their own sakes, but for our use. When a greenhouse plant dies there are plenty of recruits to fill its place.

Dr. Siemens found that all plants could not be treated alike. Particularly they varied in the amount of stimulation they could undergo. The delicate lily of the valley, grown by the aid of heat alone, and with a deficiency of sunlight, was sickly and anæmic, flimsy in texture, and with its petals thin and colorless. The electric light gave the flowers their natural rich, white, creamy color, and made the leaves strong, firm and green. Generally the natural colors of flowers were enriched by the light, and plants which would wither in a high temperature without the light, with its aid flourished exceedingly. The electric light, Dr. Siemens pointed out, would almost save its cost in stove fuel by the heat it supplied and the quicker maturing of plants, and it might be used in the orchard to counteract the effects of night frost. But banana leaves too near the lamp were scorched by its rays. Melons, cucumbers, strawberries, mustard, carrots, beans, tulips, pelargoniums, all matured under the electric lamp long before the same plants under daylight alone. Subsequent investigations have shown that a great deal of caution must be used in the application of artificial light. Every plant has its own way of responding to the stimulus.

For instance, Professor Bailey, at Cornell University, and the authorities of the West Virginia Agricultural Station, have found that cauliflowers will grow very tall, but have smaller heads, and radishes develop extraordinary profusion on "top" under the influence of the lamp. But as we do not prize the cauliflower for its stature, or the radish as a foliage plant, these advantages were not worth the cost of producing them. Nearly all flowers are found to bloom sooner, and sometimes with brighter colors. Lettuce becomes marketable four to ten days earlier, thriving best when the artificial light is only

used half the night, but some other plants run to seed under its influence instead of developing weight and succulence, and still others mature very quickly, but do not grow big, ending as tough and ancient little dwarfs of no use for the table. Spinach is particularly grateful for the electric beam, but as society does not clamor for spinach out of season the game is not worth the candle. Peas grow more quickly and are larger in the pod. Endive does better without the electric light.

Many points remain for investigation at the proposed experimental station of the Royal Horticultural Society. We want to know just what kind of light and how much of it is needed by each plant. It should be remembered that a plant five feet from the lamp gets ten times as much light as one sixteen feet away. Then the "ultra-violet" rays of the arc lamp, of such immense value to the scientist, are not good for most plants. Dr. Siemens thought if the bare light were used the benefit to the plant would increase. But the opposite has proved to be the case, and lamps with glass coverings or jackets of liquid to shut off the invisible rays have been found better. The incandescent or glow lamp and incandescent gas have also been tried at West Virginia with success. M. Deherain, at Paris, found that the invisible rays were most injurious from a 2,000-candle-power arc lamp unless shut off by glass. His conclusion was that the electric light will maintain a fully grown plant for two and a half months, but is too feeble to support a plant from infancy upward. At the Winter Palace, at St. Petersburg, some ornamental plants placed under the electric light turned yellow and died in a single night.

Professor Bailey considers that it is well established that maturity and ripening can be greatly hastened by artificial light, and that plants are not injured by "want of rest," but considers that there are many problems to be settled as to the protection of plants from too much light, and the prevention of too rapid seeding and early maturity. In short, it remains for the scientific investigator to observe the exact effect at each stage of growth of the artificial illuminant on the formation of chlorophyl, of starch, sugar, gluten, alkaloids and the plant's own essential oils, and to determine when and how long the imitation sun should be made to shine. *Boston Transcript, July* 16.

The cascades at the Colonnade of States, World's Fair, St. Louis, involve the lifting of 90,000 gallons of water, ninety-five feet every minute. The centrifugal pumps are driven by induction motors.

ELECTRICAL MACHINERY FOR PANAMA.

BY GEORGE E. WALSH.

Some $20,000,000 were spent by the early French engineering companies in purchasing machinery and supplying equipments for excavating the Panama canal, and a good part of this was finally left to rot and decay in the tropical climate of the isthmus; but there was scarcely any money spent for electrical machinery or implements of any kind. This was because electricity, as a practical power producer, had not reached a stage of development to appeal to engineers. Even electric lighting along the route of the canal was not resorted to, and the shops and repair plants were constructed without thought of any electrical equipment.

The work of finishing the Panama canal by Americans is a stupendous enterprise, and the latest machinery and methods will be employed. It has been variously estimated that it will require from six to ten years to complete the canal even under modern engineering conditions, and from one to two years of preparation will be required. The preliminary work of selecting and designing the machinery and excavating implements for cutting the hemisphere apart is now in progress. The selection of the electrical equipment for this enterprise is likely to be of considerable importance to the manufacturing world. Electricity will perform a part in the excavation and equipment of the canal that will save thousands of dollars to the engineers. There will hardly be a machine, repair shop or operating plant that will not have electric power in some portion of it. In this respect the new machinery for the Panama canal will differ radically from that shipped to the isthmus by De Lesseps and his engineers.

The effect of this has already made itself apparent in the electrical world, and with engineers and manufacturers figuring on the different electrical equipments required there is an undercurrent in the trade that promises unusual activity in the near future. Within six months the designs and specifications of some of this machinery will be finished, and the first shipments will probably be made within the current year, or the early part of the new.

"The machinery used by the De Lesseps company and its successor," explained one of the engineers connected with the isthman waterway to the writer, "was good of its time and day, but most of it was antiquated by the time it was delivered. Some of the Belgian locomotives used for carting the excavations away from the canal route were too small to do the work assigned to them, and they were abandoned shortly after they reached the isthmus. The dredges and steam shovels were mostly half the size of those which will be employed by the American company, and they were not provided with the little devices and equipments that so greatly save time and labor. The cableways that will probably be used in Panama in the next few years will practically be steel cable suspension bridges stretching from steel towers. On the platform of these towers motors will be placed for operating the hoist. The man operating the dump will sometimes be a quarter of a mile away from the excavating place, but electric signals will keep him in close touch with the work. When the 'skip' is full the foreman in the trench touches a bell, and the man on the tower starts the machinery going. The electric hoist is so nicely balanced that the operator can do almost anything with it. He raises it to any height he wishes, and runs it along to any part of the line to dump it. Remarkable speed and accuracy are obtained by means of these electric cableways and hoists. Probably three times as much work can be done by them than could ever be accomplished by the old clumsy steam hoists. Moreover, every one of these electric cableways will be connected together by telephone. The engineer in charge can thus keep in intimate touch with every part of the route.

"Very likely scores of these cableways will be shipped south, for work will spring up all along the route so that the excavation can progress rapidly. The average 'skip' or steel box that will probably be used will hold ninety cubic feet or more of material, and will travel at the rate of one thousand feet a minute. Cableways will be constructed for handling rock and soil so that practically every part of the canal can be worked without a hitch.

"Steam dredges and steam shovels will be employed by the dozens, but there will be auxiliary electric power on most of these. Both steam and electric derricks and cranes will be needed, and they will represent some of the best work of modern inventors. Compressed air and electric drills and 'channeling' machines will be employed to cut through the solid rock. When the drilling is completed the rocks will be exploded by dynamite cartridges by means of the electric battery.

"The numerous repair and manufacturing shops will dot the landscape on all sides. Before a foot of soil is excavated,

the whole outfit will be figured out in this country, and every part of the immense equipment purchased and shipped south. The engineering corps must have their plants complete before they begin operations. They must be able to forge their own materials and repair any broken machinery right on the scene. The isthmus is too far away to permit of any delay through breakdowns, and there are no machine or repair shops on the route of the canal to help the engineers out.

"Consequently one of the great features of this great enterprise will be the shipment to the isthmus of complete repair and manufacturing plants. These will all be worked out in advance, even down to the minutest detail, and then sent down to the isthmus in such shape that the engineers can work for years independent of the rest of the world. There will be machinery for forging and manufacturing many parts of the implements, or else duplicates will be carried along to be used in the place of those that wear out or break. That is the kind of work that is in preparation now, and which may take a year or two to complete. When finished, the engineers and contractors can sail down to the isthmus and begin operations without a moment's delay, and everything should proceed smoothly and rapidly until the canal is finished."

During the early efforts of the French to cut the isthmus in two comparatively little American machinery was used. Most of it was bought in France, Belgium, England and Germany. Some of the smaller supplies were purchased in this country, but probably not a million dollars' worth altogether. In the new enterprise nearly all the machinery and supplies will be purchased in this country, and all of the electrical apparatus.

Owing to the climate of the tropics the French constructed scores of hospital buildings, some of which are in fair state of repair to-day. These will be occupied by the American contractors, and every one will be lighted by electricity. The repair shops and plants will have tools and machinery operated entirely by electric power, and the drills, hammers and similar small tools will be run by small and large motors. Several hundred motors will be required for this department of the contract, while the lighting part of the enterprise will be enormous. It is proposed by the engineers and contractors to light up the route of the canal by electricity, so that work can be carried on in shifts night and day. By expediting the work in this way it is hoped to complete the canal in from five to six years, although the full limit is placed at a much longer period.

The question of motive power on the isthmus is partly dependent upon the fuel problem. Coal is scarce and high priced in Panama; wood is not to be depended upon as an exclusive fuel for power production, and the question of harnessing the tides and currents of the mountain streams and Chagres river is rather difficult and puzzling. While some attempt may be made to utilize the power of the river's flow for generating electricity, and coal and wood will be used for fuel purposes, it is possible that liquid fuel will be the chief article employed. Texas oil may be used for building the Panama canal more than anything else. The cost of shipping this to the isthmus is less than that of transporting coal or wood to the scene. Figuring on running a line of oil-tank steamers to the isthmus, some of the engineers have estimated that the cost would be considerably under a dollar a barrel. At this cost oil would be the cheapest fuel that could be used for operating the numerous plants and machinery.

The fuel problem is the first that must be settled, for with liquid fuel as the chief dependence the types of furnaces and grates would have to be modified before the orders for the machinery were placed. There is good reason to believe that many of the portable electric power and lighting plants will burn liquid fuel entirely, while many of the steam shovels and dredges will use both oil and coal. The modern convertible type of grate, which enables the engineer to utilize either coal or oil, appeals with the greatest force to those interested in work in the tropics where the fuel must be carried long distances. A good many American-made oil-burning electric plants are in operation in South America to-day, and wherever they have been used they have given satisfaction.

One feature of the new enterprise in Panama is the advertisement it will give to American-made machinery, and especially to electric light and power plants. All the South American nations are interested in the construction of the Panama canal, and the operations will be watched closely and continuously. The machinery that will do the work successfully must receive a good deal of attention, and our machines and electrical goods will have a better opportunity for practical demonstration than ever before. The difficulty of introducing American electrical goods in South and Central America, in competition with the German, French and English goods, has been largely a question of lack of demonstration. The German goods in particular are well known, and the South American mines are equipped with more German machines than any other. These have been so long in use that it requires practical demonstration of American goods to displace them. They have the further advantage of being sold by well-trained and disciplined German agents and representatives, who have a system of placing their goods on the market that is hard to beat.

In the words of a prominent manufacturer of electrical equipments in this country, who has made a specialty of South American trade, "the Germans are our greatest competitors in electrical goods. They have established a business there that can not be taken away from them unless we can demonstrate the superiority of our machines. This is difficult when the purchasers will give you no opportunity for testing your goods. We have had to set up at our own expense electrical machines in many towns and cities, and run them for nearly a year before we could get any sales. It was discouraging work, but in the end it paid. We are gradually now working our way into the trade, and American electrical goods are being used more than ever before. But the construction of the Panama canal by Americans means something more to the trade than the mere completion of a great waterway. It is going to attract all South America to our engineering methods and products. It will make itself felt twenty years after the canal is finished. When the work is completed the machinery will never be brought back to this country, and its distribution in South and Central America will tend to advertise our cause. Nothing better has happened to this country, from a trade point of view, in years than the acceptance of this contract to finish the Panama canal. It is worth two Pan-American congresses or exhibitions."

Electrical Exports to Latin-America.

The bureau of statistics of the United States Department of Commerce and Labor, in a report covering the month of April of this year and the ten months ending with April, 1904, shows that the exports of electric and scientific apparatus during the month of April to countries of Latin-America amounted to $115,464, and for the ten months ending with April, to $1,071,886.

ELECTRIC STERILIZATION OF MILK.

BY EMILE GUARINI.

The sterilization of milk is a problem that was once regarded as solved, but which is at present being earnestly discussed. The technical press has for several years been making public the profound transformations that heat brings about in the nutritive ingredients of milk. In order to sterilize milk, in fact, and guarantee its preservation almost indefinitely, it is necessary to prolong the action of fire for a considerable length of time. Ebullition of the liquid, however, even for a long time, does not by any means destroy all its germs, and, in practice, we are obliged to attain a temperature of 120 degrees centigrade (248 degrees Fahrenheit) and continue the operation for twenty minutes in closed vessels. It is not astonishing that, through such a treatment, the milk should undergo a great modification. It is especially in infants that, through the gastric disorders that it occasions, we recognize the absence of digestive properties in milk thus treated. We remark, besides, in infants fed with sterilized milk, a tendency toward rachitis, due, it seems, to a want of phosphorus. The true cause of such anomalies has been found within the last few months. A very able chemist recently presented to the Academy of Sciences of Paris a highly interesting study of this subject based upon a long series of experiments. From this it results that in milk sterilized by the action of fire, lecythine, the valuable ingredient that furnishes the organism with the phosphorus necessary for its normal development, becomes transformed and ill adapted for absorption by the stomach, especially by that of infants. Although, on the one hand, hygienists wish to ostracize milk thus sterilized, the same disciples of Esculapius, on the other, put mothers on their guard against the germs of tuberculosis insidiously concealed in milk that has not passed through the sterilizing digester. The problem that therefore confronts us is this: how shall the microbes of milk be killed without altering the latter's composition? Some efforts have been made to solve this question, and in several different ways. Ozone has been employed at various times on account of its bactericidal properties; and trial has been made also of oxygenated water, which is quite a powerful disinfectant, but the practical results obtained do not seem sufficiently encouraging to warrant the use of this agent. In order to effect the destruction of the germs without carrying the action of fire too far, a partial saturation with oxygen has been tried. It is probable that in this direction the perseverance of experimenters will some day reach the solution of the important problem of milk sterilization. Driven to despair, and not knowing to what other saint to turn, an appeal has been made by some to electricity to perform for milk one of those numerous miracles that it alone can effect. The researches made up to the present day, especially in Italy, have not, however, given the results that were anticipated. Mr. Guarini and Dr. Samarini, nevertheless, have just solved the problem at Brussels after numerous and long researches. They have not only succeeded in sterilizing milk electrically, but have also explained why their predecessors were unable to obtain results reached by themselves. The alternating as well as the continuous current had been employed and it was concluded from the unsuccessful issue of the experiments that the problem could not be solved by electricity. Such was not the opinion of Messrs. Guarini and Samarini when they took up the question, since it was evident, *a priori*, that the investigators had not made their experiments with a sufficient knowledge of the phenomena invoked by them. In fact, for the experiments with a continuous current they had employed one generated by a few batteries or a high tension one furnished by a static machine. If we consider that the deadly effects of the electric current are not produced by the tension, but by the intensity of the current, we shall see that the effects sought could be obtained in either case. In the case of batteries the tension was too low to permit a current of sufficient intensity to traverse the milk, being given the great resistance of the latter. In the second case, the tension was sufficient, but the intensity was negligible, as it generally is in static machines. In order to verify the matter, Messrs. Guarini and Samarini, after trying the experiment again, with the same negative results, rendered it more striking by substituting fishes in water for the microbes in the milk, and found that the animals exhibited no uneasiness in the presence of the current. The experimenters then employed a continuous current up to 170 volts, and, with a quart of milk, raised the intensity to five amperes. By extracting some of the milk at a certain distance from the electrodes, by means of pipettes, it was found that it was perfectly sterilized and could be preserved. Unfortunately, however, the experimenters were confronted by another difficulty, and that was that the milk, beginning in the vicinity of the electrodes, became coagulated. Upon employing fishes in water, the animals were of course perfectly electrocuted. Upon employing special electrodes with a current of water, the coagulation was much diminished and almost imperceptible. The experimenters nevertheless abandoned the continuous for the alternating current. In the first place they repeated the experiment of their predecessors, employing the Ruhmkorff coil. The milk was not sterilized, and the fishes, moreover, experienced but a slight shock. Messrs. Guarini and Samarini then had recourse to a 110-volt alternating current, with carbon electrodes. The milk was perfectly sterilized when the density of the current was adequate and was not coagulated when the frequency of the current was sufficiently elevated. It might be thought that it would prove advantageous to add to the milk certain substances of a nature to render it more conductive; but the experimenters found that such was not at all the case, and that in such an event it became necessary to employ a much stronger current. They made this fact evident by electrically treating some fishes in fresh and salt water. In the second case it required a much greater intensity to kill the animals than it did in the first, because the greater part of the current went through the water and not through the body of the living organism.

It may be concluded from these very interesting experiments that, in order to effect an electric sterilization of milk, the three following conditions must be realized: (1) the milk must be traversed by an alternating current of sufficient frequency to prevent the decomposition of the liquid; (2) the density of the current must be sufficient to electrocute the microbes; (3) the alternating current must be of a sufficiently high tension to overcome the somewhat high resistance of the milk. If we have only an alternating current of low tension at our disposal, we might at a pinch add a salt or an acid to the milk in order to render it more conductive. In this case there would be required a much greater current intensity and substances capable of being subsequently eliminated without altering the quality of the milk.

As for the practical application of the process, the apparatus for that is very simple, and consists of a well insulated receptacle and two electrodes, say of platinized carbon. Two factors evidently intervene—the duration of the treatment and the intensity of the current. Since the use of electricity is daily becoming more general, it may be that the process will be adopted to a certain extent, since it gives absolutely sterilized and in no wise altered milk.—*Scientific American, July* 16.

Electrical Notes from India.

Wireless telegraph service is to be inaugurated between the city of Rangoon, in Burma, and the Andaman Islands, a distance of between 300 and 400 miles. Stations are already in course of construction at Diamond Island, Elephant Point, Amherst and Port Blair. Amherst is located about 150 miles from Rangoon across the Gulf of Martaban. The distance between Port Blair and Rangoon is 450 miles.

The large cities, Calcutta, Madras, Rangoon and Colombo (on the island of Ceylon), afford excellent advantages in every way for the successful operation of a system of wireless communication.

The greatest signaling distance would be the 1,100 miles between Madras and Rangoon, across the Bay of Bengal. The other distances are as follows: Madras to Calcutta, 865 miles; Calcutta to Rangoon, 650 miles; Madras to Colombo, 400 miles. Although wireless signaling has not as yet proved reliable for such great distances as that between Madras and Rangoon, and Madras and Calcutta, many smaller cities along the coast afford excellent opportunities for increasing the range and usefulness of the service through the establishment of relay stations at these points.

The Cauvery power scheme may, in the near future, have to take second place as regards size among electrical installations in southern Asia. The Periyar power scheme is the most recent large electrical project now being seriously considered. The Periyar river, rising in one of the mountainous districts of southern India and flowing westward through the province of Trevancore to the Indian ocean, is the source of power.

A large masonry dam some 400 feet long and 160 feet in height was built across the river near its source in the mountains, thus forming a large water basin or artificial lake covering an area of several thousand acres. This lake was intended primarily for irrigation purposes and has been used as such. It is about twenty-two miles long, varying in width up to a maximum of about two miles. At one end of the lake is a tunnel one and one-quarter miles long, through the mountains, and in this way water is supplied for irrigation to the large tea and other plantations on the other side, over a radius of many miles in all directions. A fall of over 1,000 feet with water sufficient to supply some 30,000 horse-power during all seasons of the year is thus acquired.

As early as 1893, a committee of engineers investigated the Periyar scheme but, in those days, long-distance transmission of power was an uncertain quantity and the location of the industrial centres made necessary long-distance transmission at high voltages in order that cheap power might be supplied. At present date, it is even feasible to transmit electric power from Periyar to Madras, a distance of 340 miles, at a much cheaper rate than is possible with the use of steam for motive power. However, there are several industrial centres much nearer to Periyar than Madras, among which are Madura, Trichinopoli, Utakamund, Trichur, Cochin, Calicut and one or two others. Madura, with a population of about 100,000, is located about sixty miles east of Periyar.

Major A. J. Lotbiniere, R. E., chief deputy engineer to the government of Mysore, is, at present writing, making a tour of the most promising industrial centres which might be successfully supplied with electric light or power from Periyar. His report will be awaited with much interest. There should be no doubt regarding the success of the project providing the industrial centres respond in support of the same.

The Rangoon, Burma, electric power and lighting project has, after many months of delay, been settled decisively and the contract for carrying out the same has been awarded to a local firm by the municipal committee. The contract was originally awarded to the Brush Electric Company, of England, but, on account of the refusal of the Brush company to make certain concessions, the contract with it was canceled.

Acting upon the advice of Major A. J. de Lotbiniere, who has recently returned to Bangalore from Rangoon and who is now investigating the Periyar scheme, the alternating-current system of distribution at 2,200 volts has been chosen in preference to the 220, 440-volt, direct-current system, as heretofore advocated. The alternating system is more economical and the first cost of installation should also be less than with the use of direct current. The apparatus for power and lighting will probably be supplied by the British Thomson-Houston Company, of Rugby, England.

The electrification of the Nilgiri railway between Mellapollium and Utakamund has not been definitely decided upon. The road is not yet completed as far as Utakamund. Electric power for operating this line could be supplied from Periyar.

Railway repair shops, factories and mills in different parts of India are being equipped with motor drive, thus affording a centralization of motive power as well as the addition of economy, flexibility and cleanliness.

Plans are under way to facilitate the study of engineering in all of its branches by the addition of a large building devoted to that purpose at the University of Madras. A. C. H.

Sivasamudram, India,
June 15.

Engineers' Society of the University of Minnesota.

The year book for 1904 of the Engineers' Society of the University of Minnesota contains a digest of the thesis work at the university during the college year just closed, an article on "The Manufacture of High Explosives," by Mr. R. S. King. Mr. P. S. Smith discusses the effect of concentrated loading on concrete blocks, and Mr. P. I. Gunstad takes up the question of "The Effect of Freezing on Concrete." Professor G. D. Shepardson has a valuable paper upon "The Electrostatic Capacity of Wires," which was reprinted in the ELECTRICAL REVIEW for June 25. An experimental study of the alternating-current series motor is contributed by Mr. J. C. Vincent. Professor F. F. Flather has some notes on rope driving, and Mr. E. C. Oliver has an article on "The Solution of Problems in Spiral Gearing." Copies of this publication may be had by addressing the Year Book of the Engineers' Society, University of Minnesota, Minneapolis, Minn. The price is fifty cents.

Receiver Appointed for Gould Trolley Interests in Virginia.

Federal Judge Waddell has granted the application of the Gould interests for a receiver for the Virginia Passenger and Power Company's consolidated electric lighting, heating and power interests in Richmond, Manchester and Petersburg, Va. This application, it was alleged, was made for the purpose of preventing the disintegration of the Gould properties in these cities. It was granted at Norfolk, Va., on July 16. A suit for a receiver, instituted in the Petersburg Corporation Court by George E. Fisher, had been argued for a week, when Frank J. Gould, through the Bowling Green Trust Company, applied to the Federal Court for a receiver. The company is capitalized at $15,000,000, of which more than $12,000,000 is outstanding.

Bending Moments in Rails.[1]

Wheel effects of moving locomotives are resolved into negative and positive bending moments by the rail when depressed from its unloaded position in the trackman's surface to its loaded condition in the "general depression." From a continuous beam resting on numerous cross-ties, as flexible supports in the ballasts, and the latter upon a compressible subgrade, the rail, by the progressive loading, is converted into a "constrained beam," strengthened and stiffened to carry and distribute the driving wheel loads and the tractive effort. The cross-ties are flexible supports depressed more directly under the wheels than in the wheel spacing, and do not control the span of the bending rail, as generally supposed.

The wheel spacing and the wheel loads, loading the rails at intervals of two or three cross-ties, become the more important factors in fixing the span of the bending rails. When the rail is well spliced and stiff, it may be strengthened and stiffened by parts of the load of the locomotive for carrying and distributing the loads, etc. This favorable action of the rail as a beam loaded in the "general depression" (unique in mechanics) is in part due to the flexible supports upon which it is depressed by the several wheels of the subdivided total load, each wheel load causing conjoint strains in the metal of the section, which assists to check deflections under adjacent wheels. The foundation is also favorably loaded and restricted in its movements.

A single pair of wheels in a long wheel spacing, independent of the conjoint action of other wheels on the rail, has a limited "general depression" confined to one specific deflection under the wheel. The looseness of the track not being reduced by preceding wheels, the positive bending moment is constrained only by the superstructure, instead of adjacent wheel loads.

In some stremmatograph[2] tests the total static load of the locomotive was 220,000 pounds, drawing a train of four cars, total weight of 430,000 pounds. In another test the total static load of the locomotive was 282,900 pounds, drawing a train of nine cars, weighing 910,000 pounds—over twice as heavy, yet with its closer wheel spacing of the engine, the inch-pounds of the positive bending moments were less per pound of static load and were constrained by more efficient bending moments than for the lighter locomotive. In other words, the foundation or subgrade was more favorably loaded by the ten-wheel type of engine. These tests confirm the American theory and practice of the importance of distributing the wheel loads by well-designed wheel bases.

For the ten-wheel engine the positive bending moment for the wheels in good condition was 9.82 inch-pounds per pound of static load. Under a consolidation type of locomotive drawing freight trains, even more favorable results are obtained. With the twelve-wheel type of freight engines the results are still more favorable as to the distributed load through the rail section in loading the foundation. Details of the tests show the negative bending moments occur in the wheel spacing, and constrains the positive bending moments, which are nearly or directly under the wheels. At the points of flexure in the rail, shearing strains in the web connect the negative and positive bending moments between and under the wheels, making the action of the metal of the rail continuous in the "general depression" for the entire wheel base of the locomotive and under the first truck of the passenger coaches.

In freight service, with 60,000, 80,000 or 100,000 pounds capacity cars, with an inside wheel spacing of eighteen to twenty feet only, the "general depression" is continuous for the entire train length.

The magnitude of the constraining negative bending moments in the wheel spacing for a given unit fibre strain, under the positive moments, depends upon the stiffness of the rail section, and looseness of the track, the latter being one of the variables in the permanent way. A closer comparison is more easily made between the unit fibre strains of the negative than of the positive bending moments.

In four and one-half-inch, sixty-five-pound rails under switching engine No. 1 at the Grand Central Station, New York, having 125,000 pounds upon three pairs of drivers, the unit fibre strains for the negative moments ranged from 1,800 to 2,500 pounds for the unit fibre strains of 30,000 to 45,000 pounds. On the six-inch 100-pound rails, for similar unit fibre strains for the negative moments, the positive bending moments only had unit fibre strains varying from 6,000 to 8,000 pounds, the ratio of constraint being many times greater.

Limber rails have large unit fibre strains, but carry only small negative bending moments, and are also limited in the positive bending moments which they can sustain without exceeding the elastic limits of the metal. As the stiffness of the rail increases, with no greater unit fibre strains, larger bending moments are carried by the rails in distributing the wheel loads to the cross-ties, ballast and subgrade.

While it is easy by the construction of the wheel base of the locomotive to distribute a large total load on a stiff rail, the intensity of the pressure between the wheel contacts and the head of the rail is increased by the heavy axle loads, and the metal in our present rails under the rolling wheel contacts has much more work to do than was the case with the lighter wheel loads and more limber rail sections. The same physical properties which would sustain the light wheel loads for a large tonnage show a much greater rate of wear under the present wheel loads. The increased work of the stiffer rails and doubled wheel loads, with greater expended tractive power of the engines, should receive the attention and consideration it deserves, for our present service.

[1] Extract from a paper by P. H. Dudley read at the Atlantic City meeting of the American Society for Testing Materials, June, 1904.

[2] The stremmatograph is an instrument devised by Dr. Dudley for measuring the deflections of rails under moving loads.

Municipal Lighting of Buenos Ayres.

The June issue of the *Monthly Bulletin of the International Bureau of American Republics* reports briefly upon the municipal lighting of the city of Buenos Ayres, Argentine Republic. This city is supplied both with gas and electric lights. The electric returns from the municipal stations show that there are 387 arc lamps and 880 incandescent lamps. The consumption for the past year was 510,957 kilowatt-hours, costing the city $118,985. In addition to this, public lighting was supplied by two private companies, which furnished 690 arc lamps and a few incandescents. The cost of this service to the city was $190,053.

The electric tramway companies in the city, in accordance with the terms of their contract, supply free lighting. This service consists of 1,165 sixteen-candle-power lamps. The national government has 458 arc lamps along the water front. The commercial service of the private companies was equivalent to 254,032 incandescent lamps. The power supplied for this purpose was 7,384,689 kilowatt-hours. In addition there was supplied for power 2,351,275 kilowatt-hours, and for tramways 20,049,638 kilowatt-hours. The total supply of electric current for all purposes during the year was 32,590,907 kilowatt-hours.

Medical Electricity.

Electricity used in various forms has come to be a valuable adjunct in medicine and surgery, and undoubtedly will in the course of time be a much more important factor in the treatment of diseases and injuries than it is even now. Medical electricity is as yet but in its infancy. Of the many modes of harnessing electricity to the use of the medical man the production of X-rays is the most conspicuous, and is fast taking its rightful position as an almost indispensable means of diagnosis in certain cases.

The *Hospital* of May 28, 1904, contains a résumé of the latest literature concerning medical electricity. Brock and Stanley Green have pointed out, in the *Quarterly Medical Journal,* that the X-ray tube is of service in the more complete definition of diseased lung in phthisis. They have now had a number of cases to base their deductions upon, and declare that: (1) in no single case in which the physical signs have pointed to disease have the rays failed to detect the mischief; (2) in some cases in which physical signs have been absent the rays have shown deposits in the lungs, and in these cases physical signs have subsequently been detected; (3) the early diagnosis is certainly helped; (4) that the extent of the disease is in many cases shown to be greater than the physician thinks; (5) that the progress and results of treatment can be watched with greater accuracy.

Chisholm Williams, in the *British Medical Journal,* gives favorable testimony as to the beneficial effects of high-frequency currents in the treatment of phthisis. In 1901 he recorded forty-three cases under treatment, and now of these, three have died of pneumonia, of tuberculous kidney and of lardaceous disease. He advises that the apparatus be the most powerful available. In tuberculosis of other parts, joints, etc., the best results have been obtained by general electrification combined with a high-vacuum electrode used from the resonator, or the ordinary X-ray discharge. Cases of old-standing tuberculous lesions he states to be very amenable to treatment. In the treatment of lupus he finds the X-ray tube as reliable and to produce as good results as the light treatment. He urges the use of the high-vacuum electrode with a vacuum high enough to produce fluorescence on an X-ray screen. Also the patient should receive on the condensation couch as much as 350 milliamperes and upward. In opening the discussion upon the subject of electrotherapeutics in the treatment of malignant diseases, at the annual meeting of the British Society of Electrotherapeutists, Lewis Jones raised numerous questions of the first importance which demand solution ere much advance can be made. Notably is this the case in the matter of what kind of rays are of most advantage—whether the "X-rays," "cathode rays," or a combination of the two. He personally recommends the use of a "medium" tube, and prefers to operate with the anti-cathode red hot. He avoids dermatitis by arranging the exposures suitably, and continues the treatment for three, four or five months.

Alan Jamieson, writing in the *Lancet,* in referring to the employment of hard or soft tubes in X-ray work, states that he has found that weather affects the rays materially, *e. g.,* on cold, raw days reactions more readily occur. Wild, in the *Medical Chronicle,* has grave doubts as to the prophylactic value of the X-rays in preventing recurrence after operation for cancer. A case of splenomedullary leukæmia, reported in the *Medical Record,* August 22, 1903, has been treated by Nicolas Senn with great success, and other similar cases have been since reported.

On the whole, notwithstanding the many instances in which skin diseases, and even malignant diseases of a superficial nature, have been treated successfully by this means, it is as a diagnostic agent that the X-rays have yielded the most brilliant results. As remarked before, however, we are only upon the threshold so far as the use of electricity in medicine and surgery is concerned.—*Medical Record, July* 16.

Official Inspection of the Rapid Transit Subway in New York City.

An official inspection of the rapid transit subway in New York city was made on July 20 by the Rapid Transit Commission and others. Contractor John B. McDonald personally conducted the party. Mr. August Belmont, president of the Interborough Rapid Transit Company—the company which will operate the cars running through the tunnel—was represented by his brother, Mr. Perry Belmont.

The visitors were conveyed through the tunnel on flat cars pushed by a small locomotive. The train left the City Hall station at 1.40 P. M.

In the party were Mayor McClellan, President Orr, Commissioners Starin, Smith and Langdon, acting chief engineer George S. Rice, E. P. Bryan, vice-president of the Interborough Rapid Transit Company; S. L. F. Deyo, chief engineer of the construction company; Charles A. Coffin, president of the General Electric Company; Supreme Court Justices O'Brien and Hatch, President Fornes, Paul D. Cravath, H. H. Vreeland, President Underwood, of the Erie; John B. Stanchfield, Richard Delafield, John Whalen, J. Edward Simmons, George W. Young, Senator Dowling, Harry B. Platt, J. Waldo Smith, Harry B. Reed, H. D. Lyman, R. A. C. Smith, and Aqueduct Commissioners Curtis, Ryan and Windolph.

The first stop was made at the Twenty-third street station. This is one of the largest stations, and extends under the Mercantile Building. The train slowed up at Times Square, and the party inspected the work going on under the new building of the *New York Times.* The foundation of this building, it will be remembered, straddles the subway construction. Most of the stations were found to be in practically complete condition. The construction which is going on at Times Square has proven a material obstacle to the completion of the station at this point, and another part of the structure which is in a very backward condition is at the Brooklyn Bridge station. It has been announced by the contractors and several others in authority that the road will surely be in running operation by September 1. The possibility of labor troubles, however, may make it some time before the carrying of passengers can be undertaken.

The Iowa Engineer.

The June issue of the *Iowa Engineer,* published quarterly by the engineering departments of the Iowa State College, Ames, Iowa, contains several articles of interest to electrical engineers. Professor L. B. Spinney discusses incandescent lamp testing. Mr. J. C. Horning writes under the caption, "The Relation Between Central Station Heating Plants and Existing Electric Light and Power Plants," devoting particular attention to hot-water heating. Mr. A. H. Hoffman contributes a short note on "Modern Practice in Direct-Current Dynamo Design," with two valuable tables containing a large amount of data which he has collected. One of these takes up German generators, and shows, he believes, the average Continental practice. The other takes up American and English generators. These tables not only give the dimensions of the machines, but a large number of constants which have been computed. Professor P. S. Lanphear, under the title, "Some Notes on Dynamo Designing," explains the method of obtaining and the use of the constants given in these tables. There is also an interesting article on "A Study of Mine-Surveying Methods in Their Application to Mining Engineering," by Mr. L. E. Young.

NEW SWITCHING STATION AT COLORADO CITY.

SUBSTATION "B," COLORADO SPRINGS ELECTRIC COMPANY.

The Colorado Springs Electric Company has just about completed a new switching station in Colorado City for greater convenience in handling its transmission circuits. As an example of simplified construction and admirable adaptation of means to ends, the installation possesses particular interest. The station is located in an alleyway just off Eighth street and Colorado avenue, and is a one-story brick building thirty-one feet long by twenty-eight feet wide, rising above ground sixteen feet to the eaves. The walls are one foot thick and the foundation is of concrete, the roof being of corrugated iron supported on wooden rafters and beams. Substation "B" is the name of the new building in the records of the operating company and it is purely a switching station, the intention being to run it without the services of a permanent attendant.

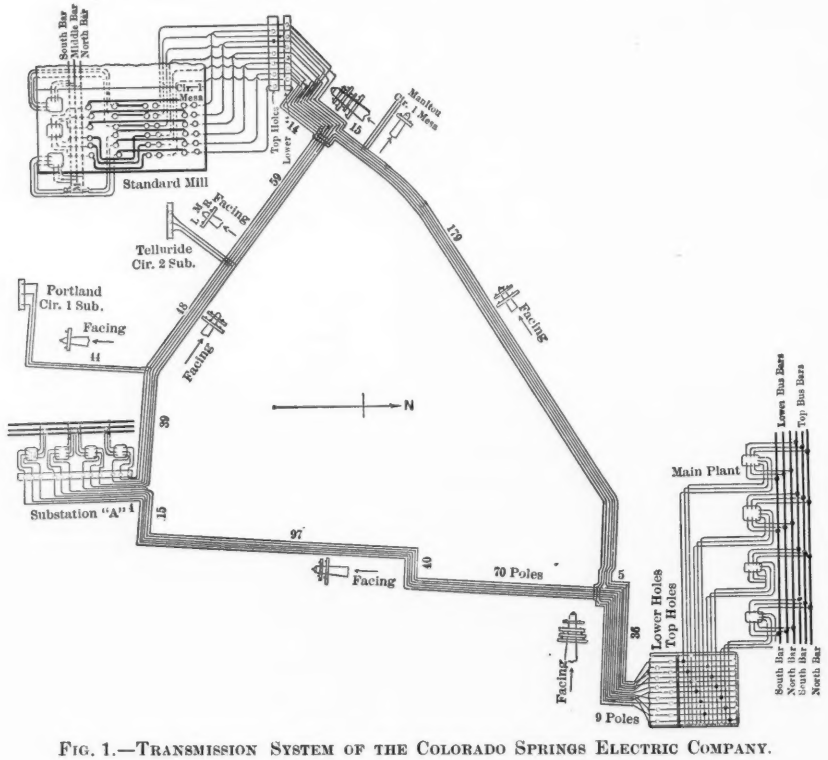


FIG. 1.—TRANSMISSION SYSTEM OF THE COLORADO SPRINGS ELECTRIC COMPANY.

As may be seen from the accompanying diagram, Fig. 1, the transmission system of the Colorado Springs Electric Company at present forms a triangular scheme of lines, connecting the main plant at Austin's Bluffs (described in a previous issue of the ELECTRICAL REVIEW) with a distributing station in Colorado Springs known as substation "A," and joining the Standard mills at Colorado City with the main plant and the substation "A" by the other two legs of the triangle. Throughout the system 6,600-volt transmission is employed, three-phase, sixty-cycle current being supplied. The main plant at Austin's Bluffs operates the lighting and power business of Colorado Springs and furnishes current for motors and lights in the three great gold mills of Colorado City—the Portland, Telluride and Standard mills. Colorado City is also supplied with current from this plant. Distribution in both the "Springs" and Colorado City is effected with 2,300-volt, single-phase lines carried back to substation "A" at the Springs. It will be seen that the connections at the Standard mill at present enables power to be transmitted from the main plant to the Springs in a roundabout manner in case the two direct lines between Austin's Bluffs and substation "A" go out of service, and in a similar manner the mill could receive power from substation "A" if its own main lines across the Mesa to the power plant were cut off.

The new switching substation "B" will do away with the present complexity at the Standard mill, and will shorten the wiring layout from Colorado City to the mill, as it is located almost exactly at the present junction of the Mesa lines with the circuits coming from the Springs. The switching station will take care of the following lines: two circuits of No. 1 copper from the main plant *via* the Mesa; two similar circuits from substation "A," and two circuits of No. 000 from a new supplementary plant which will be completed in the near future at Manitou. There will also be a line from station "B" to the Standard mill. The distance between the main plant and substation "A" is about five miles; from "A" to "B" station, about three miles; from "B" station to the main plant, nearly five miles; and from "B" to Manitou, approximately four miles. Poles of Oregon cedar averaging forty feet in length with eight-inch tops are used on the new line to Manitou, and the junction pole at Eighth street is set in concrete. Hemingray No. 2, triple-petticoated glass insulators are used on the entire system, which is spaced in eighteen-inch equilateral triangles in all new work.

On the east side of the building, as shown in Fig. 3, is erected a receiving wire trellis made of four, four-inch by six-inch pine stringers about forty feet long, secured to the poles by cross-pieces and bolts. Right angle turns are made in each entering line, which is dead ended on insulators and tapped for the run from the trellis into the building. The trellis is about eight feet wide, and two drip loops are bent in each of the wires of the transmission lines before it enters the building. Although it might appear

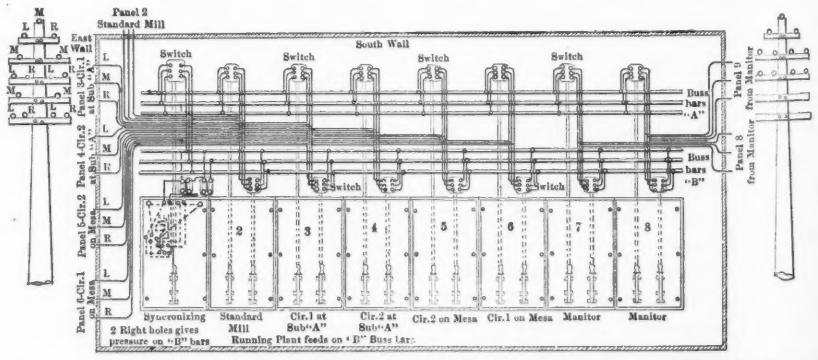


FIG. 2.—CONNECTIONS AT COLORADO SPRINGS ELECTRIC COMPANY'S SWITCHING STATION.

at first blush as though this construction were unduly substantial for a voltage as low as 6,600, it is evident that the company means to take no chances of shutdowns on account of line troubles in special work, and the straightforward ruggedness of the wiring supports can not but be favorably criticised. After the lines make the turn they are carried from the trellis to the wall ducts on insulators mounted upon a cross-piece supported on angle irons. These angle irons project from the wall horizontally, and are turned up at the ends inside the building. The wires are carried into the station through vitrified telephone conduit, the inside of the pipe being plugged with specially treated wood surrounding a hard-rubber tubing holding the wire in its centre. These ducts are inclined downward and outward at an angle of thirty degrees, for drainage purposes. A similar trellis is erected on the west side.

Inside the station, the floor is composed of three and one-half inches of concrete with one-half inch of finish, and the rafters are treated with a cold water, fireproof paint. Ordinary lime mortar was used between the brick courses. Iron bars are set into the window casings to protect the equipment from injury by thoughtless outsiders, in the absence of an attendant.

As soon as the lines enter the building they are tapped to a series of banks of General Electric carbon lightning arresters by No. 4 copper connecting wires. The arrester installation is one of the most interesting features of the station. Each entering wire is tapped by a No. 4 lead to a bank of eight arresters mounted in two vertical rows of four each. There are eight air-gaps between each line and ground, the four arresters of each row being in series, and the two rows in multiple. Ordinary 2,300-volt arresters are connected up for this 6,600-volt work in the manner described, the experience of the company having shown the advantage of the double air-gap path to ground. The lines of the system are located almost at the base of the Pikes Peak range of the Rockies, at an altitude of about 6,000 feet, and lightning storms are frequent and violent. The arrester banks are mounted on two, two-inch by six-inch hickory panels, fastened to the wall by wooden beams four inches by four inches. The arresters are spaced eighteen inches apart on centres, and the panels were treated with fireproof paint. A common ground wire of No. 4 copper connects the bottoms of the arresters with a No. 16 copper ground plate, thirty inches by forty-eight inches, set in coke and water, outside the building. Fig. 4 shows the switching apparatus from behind the switchboard.

The switchboard is composed of eight sixty-inch by twenty-four-inch panels of blue Vermont marble, two inches thick, supplied by the General Electric Company. The overall length of the board is sixteen feet, and its striking feature is the absence of apparatus; all but one panel carrying simply two oil switch handles, and no wiring being brought to the back of the board except for the instruments on that one panel. Fig. 2 shows the switching connections, which are designed to enable any circuit to be thrown upon either of two sets of bus-bars running on a frame behind the board; also, the two sets of bus-bars may be thrown into multiple.

The first panel carries an edgewise voltmeter, a synchronizing indicator, lamps, plugs and a paralleling switch for the two sets of bus-bars. The second panel carries the two switches for throwing the Standard mill line upon either set of buses, and the other six panels take the incoming transmission lines. No transformers are in the building, except those of the switchboard instruments, and the incandescent lamps which light the single room of which the interior is composed receive their current from a small transformer mounted on one of the poles outside. All the apparatus is General Electric. Rubber-covered No. 1 wires are run inside the building.

The face of the switchboard is ten feet from the south wall, and behind it, about six and one-half feet away, is a frame made of one and one-half inch iron pipe, which carries the switches, which are of the oil-break type operated by rods and cranks connecting them with the main switchboard panels in front. These switches are of the quick-break type, but are non-automatic, and all but one are of the General Electric "type F, form K" make, with a capacity of 250 amperes at 6,600 volts. The oil switch for paralleling the two sets of bus-bars has a capacity of 4,000 kilowatts. A clear space of about forty-two inches exists between the south wall and the oil switch rack. The station is provided with a common battery telephone connected with the Colorado Telephone Company's system through a leased line, and the total cost of the building and its equipment was in the vicinity of $10,000.

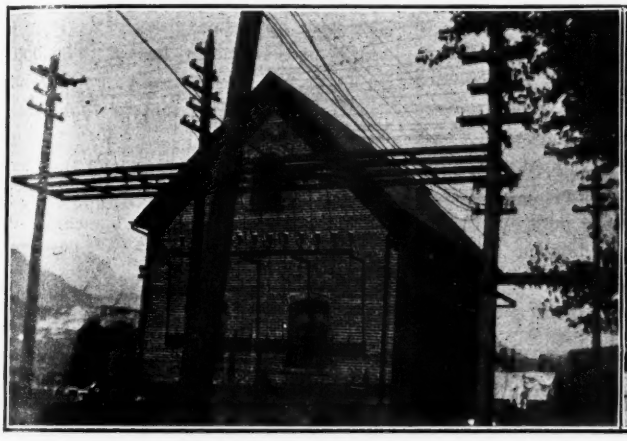


FIG. 3.—NEW SWITCHING STATION OF THE COLORADO SPRINGS ELECTRIC COMPANY.

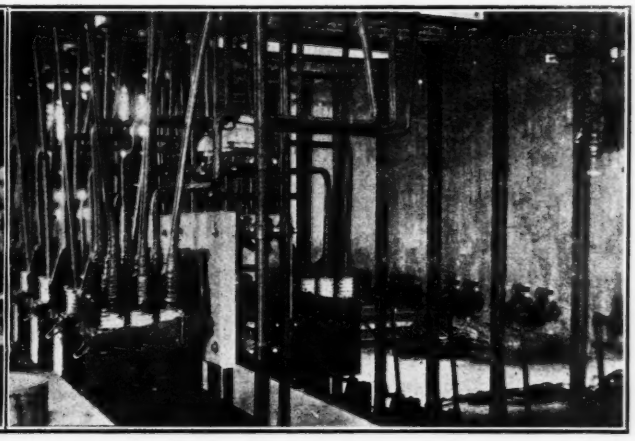


FIG. 4.—INTERIOR VIEW OF NEW SWITCHING STATION OF THE COLORADO SPRINGS ELECTRIC COMPANY.

The Electrification of the Northeastern Railway, England.

About the first of July the full schedule of electric trains was started on the Tynemouth & Newcastle section of the Northeastern Railway, the electrification of which has been in progress during the past eighteen months. Hourly trains are run by electricity between Newcastle and Tynemouth. There is an express service of electric trains between Newcastle and Monkseaton Bay and Tynemouth, by way of Backworth. It is expected that the service will be increased within a short time.

BOOK REVIEWS.

"A Text-book of Electrical Machinery." Harris J. Ryan, Henry H. Norris and George L. Hoxie. Vol. i. First edition. New York. John Wiley & Sons. Cloth. 258 pages. 6 by 9¼ inches. Many diagrams. Supplied by the ELECTRICAL REVIEW at $3.50.

The title of this excellent book is rather misleading, as it deals almost entirely with the physical laws on which electrical machinery depends for its operation, the machines themselves being but briefly referred to. The method of treatment is quite different from that usually adopted in books intended for the classroom, as the periodic or alternating currents are first considered, the direct current being considered as but a special case of the former. This method is certainly logical and would seem to have a practical advantage, in that the student will take up the consideration of periodic currents while his calculus is fresh. The use of complex quantities is also to be commended, as this simplifies greatly the analytical work. The method followed in the book may be readily gathered from the following chapter heads, which are given consecutively: electricity and magnetism; fundamental and derived units; periodic curves; complex quantities; laws of the electric circuit; electric power; magnetomotive force; the laws of the magnetic circuit; rotating magnetic fields; the electrostatic field; losses in electric circuits. Chapter ix, upon the electrostatic field, gives a good deal of valuable information on a subject which is daily becoming of more importance. The last chapter, on the losses in electric circuits, gives the effect of resistance, inductance, skin effect, eddy currents, capacity and hysteresis. There is an appendix containing tables for copper and aluminum wire, and some of the newer problems encountered in high-tension transmission.

"Dynamo-Electric Machinery." Sylvanus P. Thompson. Vol. i, continuous-current machines. Seventh edition. New York. Spon & Chamberlain. Cloth. 984 pages. 6 by 9 inches. Many illustrations. Four plates. Colored wiring diagrams and thirty large plates of dynamo parts. Supplied by the ELECTRICAL REVIEW at $7.50.

This is the authorized American edition of Dr. Thompson's classic on the dynamo. The character of the book is too well known to need comment. The author has a remarkably lucid style and a way of making difficult points clear and interesting. In fact, one criticism that has been made in regard to his writings is that they are too easy. His manner of explaining abstruse problems is so easy to follow that the student does not appreciate the difficulties and the stumbling blocks over which he is helped, and, as a result, he is apt to forget much of what he has read. This fault, if it can be called a fault, is easily remedied by supplementary work and problems. In the new edition Dr. Thompson has eliminated some of the matter of the old editions which had become obsolete, and has introduced a good deal of new material. This applies particularly to the chapters on dynamo design. The work here shows evidence of the study of American practice. The use of colored charts, explaining the different types of winding, is of material help to the student in understanding this puzzling subject. This volume comprises parts of the previous two volumes, but omits that part on alternating currents and alternating-current machinery. It contains all the work on direct-current dynamos and motors. Many illustrations are new, showing recent practice. This is true both of machines and accessory devices. Those parts relating to new types of machines—such, for instance, as boosters and special types of dynamos for use with the newer prime movers—have also been enlarged. This volume, containing nearly a thousand pages and a large number of plates, is rather awkward to handle, and one regrets that the publishers did not see fit to divide it. On the other hand, two volumes would not have been quite so convenient for reference.

"Electric Motors." Henry M. Hobart. New York. The Macmillan Company. Cloth. 458 pages. 6 by 9 inches. 480 illustrations. Supplied by the ELECTRICAL REVIEW at $5.

Mr. Hobart's writings are widely appreciated for their clearness and authoritativeness, as he combines the skill of the designer with the ability to express himself in writing. This book differs from those which have preceded it. There is no long discussion of the theory. The first chapter compares the relative merits of alternating and continuous-current motors. A chapter is then given to a discussion of the operation of the continuous-current motor, this being followed by data for motor designing and types of windings. Chapter vi, on motor designing and testing, deals with the various factors affecting this work. A number of designs are illustrated and described, the effect of varying the form of the parts is discussed, and the question of cost taken up. In chapter vii the standardization of electric motors is considered, and this is followed by a long chapter containing examples of motor design by different manufacturers. Those particularly interested in designing will find chapter x of much help, as this gives a set of comparative designs for a single motor. Special types of motor and methods of regulation are then described, this closing the first part of the book. Part ii deals with alternating-current motors, taking up first the desirability of using polyphase currents and the factors influencing this work. Chapter xiii deals with methods of starting induction motors, and chapter xiv compares this type of motor with the continuous-current motor. The design of induction motors is then discussed fully, followed by examples of practice. Commutating alternating-current motors is referred to but briefly, as this subject is hardly far enough advanced to be incorporated in the book. There is, however, an excellent bibliography and a list of alternating-current commutating patents relating to alternating-current commutating machinery. There are several appendices, giving the properties of copper wire and the values of certain constants used in motor design. The book is probably the most complete and advanced treatise on electric motors that has yet been published.

"Naval Electrician's Text and Handbook." Lieut. W. H. G. Bullard, U. S. N. Annapolis. United States Naval Institute. Flexible leather. 547 pages. 4 by 6 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

The aim of this book has been to collect, in compact form, such information and data as will lead to a clear understanding of the operation of electrical machines, appliances and instruments that are used on the vessels of the navy, in order that the men in charge may gain a correct idea of the principles upon which such machines are constructed, and thus obtain an intelligent conception of their proper care and handling. Chapter i opens with a discussion of the various electrical and magnetic units in use, giving the derivation and the relations between them. For a text-book this would be an unfortunate method of treatment, it being far better to take up the principles and laws first and then define the units, as they will have at that time a definite meaning. However, in a handbook the logical method can not always be followed, as much must be sacrificed for the sake of brevity and convenience in reference. Chapter ii deals with resistance and chapter iii is an elementary treatise upon primary batteries, chapter iv dealing with service and other batteries for special purposes. It is rather surprising that there is here no reference to the storage battery, which is certainly a device of importance to the naval engineer. Some in-

formation in regard to this device might have been introduced in place of the discussion on the best arrangement and efficiency of batteries, a subject which is of theoretical, rather than practical, importance. Chapter v, dealing with Ohm's law, shows its application to various circuits. The general laws of magnetism and the electromagnet are dealt with in chapter vi, and the principles of the magnetic circuit are explained. Electromagnetic induction and the principles of transformers are treated in a very elementary way in chapter vii, and this is followed by the theory of the dynamo in chapter viii. Chapters ix, x and xi deal with the dynamo in general. Service dynamos are next considered, followed by a discussion of the principles of the motor and the application of motors on shipboard. Some of the information here would hardly be appreciated by the dynamo tenders on shipboard, and might properly be omitted. Incandescent and arc lamps are explained, and the chapters on wiring and wiring appliances and fixtures and wires are good, as are also those on measuring and testing. The chapter dealing with the care of an electric plant and accessories is excellent, giving specific directions for this work. The various electrical means of communicating are explained, including ship telephones and wireless telegraphy. There is also a chapter giving miscellaneous notes and tables, and one containing problems intended to bring out the principles explained previously. The index is not satisfactory, for it is merely a list of chapter headings. A book of this kind should have a full alphabetical index with many cross-references.

"Congrès de la Houille Blanche." In two volumes. Grenoble. Syndicat des Propriétaires et Industriels Possédant ou Exploitant des Forces Motrices Hydraulique. Cloth. 606 and 666 pages. 7½ by 11 inches. Fully illustrated. Supplied by the ELECTRICAL REVIEW at $7.75, postage extra.

These two volumes give a complete account of the work of the Congrès de la Houille Blanche, held in the fall of 1902. The French are always happy in their writings and addresses, and these volumes are no exception. Even the rather poetical name adopted by the society is pleasing and quite as significant as if the name of "The Water Power Society" had been adopted. The first of these volumes contains the work of the congress, and in it will be found, in addition to several very appropriate addresses, a number of valuable papers relating to water-power development. While these relate more particularly to France, they will be exceedingly helpful to any engineer interested in water-power development. There is a paper on climatology and hydrology, by M. Wilhelm, engineer of bridges and embankments; a study of the hydrology of the Montagne Basin, by M. R. de la Brosse; M. René Tavernier contributes a study of the influence of snow and glaciers on the flow of rivers; M. Albert Crolard has a study of the regulation of water courses by means of lakes and reservoirs; M. L. P. Drouhin discusses the best system of taking water, and the industrial phases of the problem are discussed by M. A. Goucher. Papers relating more particularly to electrical engineering are contributed by M. R. B. Picou, on "Electrical Installations"; by M. Fajet, on "Transformer Apparatus for Alternating and Continuous Currents"; by M. A. Blondel, on "A Rapid Method of Calculating Aerial Conductors"; by M. A. Boissonnas, on "Transportation of Electrical Energy"; by M. Joseph Petit, on "Electric Traction." There are other important papers dealing more with the mechanical and civil engineering sides, such as the testing of turbines and the design of dams. Vol. ii contains well-illustrated descriptions of the visits made by the members of the congress to various French water-power developments. . These descriptions are rather general, but in every case the importance of the development is indicated and the equipment mentioned. In looking over this volume, one is much impressed with the amount of development which has been made in this field in France. The two volumes, although purporting to deal mainly with French conditions, form an extremely valuable addition to the literature of this important field.

Surface Contacts.

Out of a total of 109 defective boxes, in the surface-contact system at Wolverhampton, England, says C. E. C. Shawfield, in nine cases the trouble was due to moisture in the granite basin, that is, to the accumulation of water on the surface of the granite basin under the dope, which formed a leakage path to the top plate. This may be said to be due in every case to carelessness in fixing in the first instance, sufficient care not having been taken to see that the interior of the granite basin was thoroughly clean and well brushed over with a coating of hot dope before the remainder of the dope was poured in. The remaining 100 defective boxes were the result of damage done to the interior of the cups by heavy and repeated short-circuits. These short-circuits are caused by pieces of scrap iron which are picked up by the magnet system and come in contact at the same time with the collecting skate and with a cross rail at junctions and turnouts. The effect of a number of short-circuits on any one cup is that the interior of the top half of cup becomes burnt and charred, and thus loses its insulating properties, consequently the top plate or stud becomes alive at an electromotive force, which may be anything from a few volts up to nearly the full line pressure.

In this connection it is interesting to note that recent experiments made by the author show that the degree of damage to the cup in the event of a short-circuit depends entirely upon the time element of the circuit-breaker controlling the main feeder. When the traction switchboard was installed at the power station the possibility of the adoption of a surface-contact system had not been considered by the tramways committee, and the circuit-breakers for the tramway feeders were specially designed to give a comparatively slow break, with the object of preventing the rise of pressure which is frequently caused by the sudden rupture of an inductive circuit. Experience has shown, however, that this is the very worst type of apparatus that could have been selected for use with the surface-contact system, as it allows the heavy current due to a short-circuit to flow for a sufficient length of time to give rise to a considerable amount of arcing or flashing between the carbon contacts inside the cup, resulting in the charring of the latter and sometimes in the fusion of the copper ribbon. The author is now replacing the original circuit-breakers with others of a new type which gives a more rapid break with magnetic blow-out, and as a result of experiment he has found that with the circuit-breaker set to operate at 600 amperes the tramway bus-bars may be short-circuited a large number of times in rapid succession through the contact-making mechanism of the cup without the latter receiving any appreciable damage, and he has every reason to believe that this alteration in the type of circuit-breaker will very greatly reduce the number of defective boxes in the future.

A Paint for Wood or Stone that Resists all Moisture.

The following recipe for a waterproof paint for wood or stone is given in the *Architect and Builder.*

Melt twelve ounces of resin; mix with it thoroughly six gallons of fish oil and one pound of melted sulphur; mix some ochre or any other coloring substance with a little linseed oil, enough to give it the right color and thickness; apply several coats of the hot composition with a brush. The first coat should be very thin.

Higher Education in Germany and the United States.

Rudolf Tombo, Jr., Ph. D., registrar of Columbia University, makes the following contribution to *Science*, July 15.

An article on "Thirty Years' Growth of German Universities," which recently appeared in one of the educational magazines, suggests an investigation along similar lines with reference to our own country and a comparison of existing conditions. There can be no doubt of the fact that there is manifested in this country an increasing purpose to lead the intellectual or the scientific life, which will inevitably tend to raise the standard of American civilization and culture. The growth of our leading universities within the past decade bears eloquent testimony to this fact, and we have no reason to be dissatisfied with the progress that has been made in the field of higher education. A mere glance at the figures in the above-mentioned article describing the growth of the higher institutions of learning in Germany will convey a good idea of the marvelous intellectual advancement of the nation since the Franco-German war. The author shows that, while there has been an increase of 38.9 per cent in the male population of Germany between 1870 and 1900, the number of students in attendance at the universities and schools of technology, mining, forestry, agriculture and veterinary science has grown no less than 163.8 per cent, and allowing graduates of these institutions also to enter into his calculations, he finds that in Germany the number of men of university training has doubled within the last thirty years. The total number of university students for 1900 is given as 46,520 and the number of males in the population of the country as 27,731,000, there being thus 16.78 students for every 10,000 males, as against 8.83 thirty years ago.

In attempting to compare the educational conditions represented by these figures with those of the United States, several obstacles are encountered at the very outset. In the first place, American statistics would not be complete and would not constitute a fair criterion of the educational characteristics of our country, were we to exclude from them all women students, for aside from the large enrolment at colleges for women and the great body of women pursuing graduate or professional courses at the universities, it is not at all unusual to find the women in the collegiate departments of our larger universities, especially the state institutions, far outnumbering the men. It is scarcely necessary to state that in contradistinction to this state of affairs, the policy of permitting women to study at the German universities is just beginning to be looked upon here and there with any degree of favor. It would hardly be appropriate to deny women a place in the intellectual activities of our nation, and we shall, therefore, arrive at a fairer basis of comparison if we take into consideration not only the number of male inhabitants, but the total population of the country. Adopting this basis, we find that in Germany's population of over 56,000,000 there were in 1900 about eight students for every 10,000 inhabitants.

In the second place, it would be manifestly unjust to Germany were we to draw conclusions in regard to the relative participation of the people in higher education in this country and in Germany without first making deductions for the further dissimilarities of conditions that confront us at every turn. The term higher education, as employed in the United States, is a more comprehensive one than it is in Germany, including as it does with us a large number of college students and students in the academic departments of universities who would not be regarded in Germany as university students. Moreover, in Germany every professional student is in reality a graduate student; no one is permitted to matriculate in the faculty of law, medicine, or theology without possessing the *testimonium maturitatis*, the equivalent—in general terms—of our baccalaureate degree, whereas we can boast of only a few institutions that call for a first degree as a prerequisite for admission to any one of these faculties, notably Harvard University for law, medicine and theology, Columbia University for law, and Johns Hopkins University for medicine. It seems reasonable to suppose that at least the more prominent American universities will adopt the higher admission requirements for the professional faculties within the next decade. At all events, even the most strenuous opponents of the theory must admit that the recent growth of the Harvard law school, which can point with pride to an enrolment of 700 students, is a splendid justification of the lately adopted ideal condition.

Turning from the American professional schools with their inferior requirements to the so-called graduate of postgraduate faculties, we meet with conditions that are most encouraging, for the number of graduate students in our universities has more than doubled within the past five years. Columbia University alone has almost 700 resident candidates for the higher degrees registered under its graduate faculties of political science, philosophy and pure science, the majority of whom are preparing themselves for the teaching profession. And here we have another encouraging feature of the educational development of our country, *viz.*, the improved facilities for intellectual growth offered to our teachers by means of summer schools, extension courses, public lectures, and similar enterprises conducted under the auspices of our leading universities. At its summer session of 1903 Harvard enrolled almost 1,400 students, and almost 700 students are at present pursuing resident work at the Teachers' College of Columbia University, which this year is also giving extension courses to 1,600 students.

Having called attention to the difficulty of making direct comparisons of the growth of higher education in Germany and the United States, let us at least examine some of the salient features of this growth in both countries. Viewed from the standpoint of increase of proportion of students to the entire population, the comparison slightly favors the United States, although the difference is not great, and the advantage would be lost entirely were we to make due allowance for the differences in conceptions discussed above. The following figures will serve to illustrate this point: in 1870 the United States had a population of 38,000,000, which by 1900 had increased to 76,000,000, *i. e.*, it had virtually doubled. In 1872 there were 8.52 students of both sexes in all branches of higher education to each 10,000 inhabitants, whereas in 1900 there were 19.13, somewhat more than twice as many. In Germany the increase between 1870 and 1900 was a little less than double, from 8.83 to 16.78 students for every 10,000 males, the total population of the country having increased from 41,000,000 in 1871 to 56,000,000 in 1900. We must also take into consideration the fact that the United States is growing much more rapidly than the German Empire. In the last decade of the nineteenth century the population of Germany increased fourteen per cent, while that of the United States increased almost twenty-one per cent, and this great increase in the population of our own country is comprised largely of immigrants, of whom only a relatively small proportion is interested in higher education. Another interesting fact is brought out by comparing the actual numerical growth of

the student body of the two countries, and employing this basis, the comparison would again favor the United States. Between 1889 and 1900 the total number of students in attendance at the German universities increased thirty-six per cent, whereas in America between 1890 and 1901 the total increase in the number of undergraduates and resident graduate students in universities, colleges and schools of technology amounted to eighty-six per cent, and there would be little change in the relative growth were the comparison extended to cover the past thirty years.

One of the most interesting points adduced in the article mentioned is the marked change in the distribution of the students among the different classes of institutions, the figures demonstrating that the schools of technology have since 1892 expanded uninterruptedly and much more rapidly than the general universities. The reason for this expansion is to be sought not so much in the existence of lower entrance requirements for the schools of technology, nor in the circumstance that several schools have been permitted to confer an engineering degree, although both of these factors have some bearing on the development in question. We must go further to find the true cause. During the past decade Germany has made tremendous advances in the field of industries and manufactures, just as has the United States, and the main reason for the increase in the number of students of technology in both countries—the multiplication of this class of students in our own country during the past decade has been quite marked—is found in the endeavor to supply a demand, the prospective student carefully weighing the chances of earning a livelihood in one field or another. Wherever the supply begins to exceed the demand, a tendency toward reduction is immediately felt, as witness the falling off in the number of medical students in this country and elsewhere during the past year, which in spite of increased standards of admission and other minor causes, must be attributed in the main to the existing superabundance of physicians. In other words, at the present day when the professional schools are making such headway at the expense of the old general culture course, university attendance becomes more and more influenced by existing economic and industrial conditions, especially in a country like the United States, in which the practical side of life is emphasized with such vigor, and likewise in a country such as Germany, which during the past few years has adopted so many of our own methods in the conduct of its industrial and commercial affairs. While Germany can not be said to have sacrificed any educational ideals for this new movement, it has at all events allowed the influence of things practical to be strongly felt. In connection with this important question of the widespread increase of applied science students as affecting both Germany and the United States, we might point out that in no instance does a German school of technology form a coherent part of a university proper as is so frequently the case in this country. And what is more, it seldom happens that a German technological school is located in a university town, and more than one such school is never, under any circumstance, allowed to exist in the same city, whereas in the United States we revel in the luxury of supporting several technological departments within hailing distance of one another, to mention only Harvard University, the Massachusetts Institute of Technology and Tufts College, for Boston, and Columbia University, the Stevens Institute of Technology and New York University, for New York city, all of which institutions offer courses in applied science.

Nothing furnishes a more vivid illustration of the practical tendencies visible in American education than the existence of departments of commerce and accounts as constituent parts of several of our leading institutions of learning, and the contemplated establishment of a school of journalism in connection with Columbia University is but another phase of this constant and growing endeavor to enlarge the field of legitimate university activity in practical directions.

Summarizing briefly, we have found that both in Germany and in the United States wonderful progress has been made in recent years in the spread of higher education, and this development may be regarded as a specific manifestation of the general material prosperity which has characterized the life of both countries during the past thirty years. The amazing development of the industrial activities of both nations has found a decided reflection in the rapid increase in the enrolments of the schools of technology and the university faculties of applied science, an increase far above the normal and illustrative of the modern striving to bring education into closer and closer accord with the living issues and problems of the day. And no harm will result from this tendency, provided the proper ideals are never sacrificed to the popular demand, for there seems to be no cogent reason why the intellectual advancement of a nation should not be in perfect harmony with all those things that constitute the sphere of its practical activity. The future of higher education in Germany and in the United States will be proof against all attacks, provided there is no diminution in the proportion of persons animated by a desire to lead the intellectual life, and provided further that we never cease to adhere to those ideals of scholarship and learning which have contributed in such bountiful measure to Germany's commanding position in the educational world.

German Electrical Industries.

The condition in the electrical industries in Germany is indicated in the following report from United States Consul-General Richard Guenther at Frankfort. The second part of the annual report of the Frankfort Chamber of Commerce for the year 1903 has just been published. It includes a statement made by the Lahmeyer Electric Company that "the increased activity of Germany's industries during 1903 has had a corresponding effect upon the company's business and that of the electric branch of Germany generally."

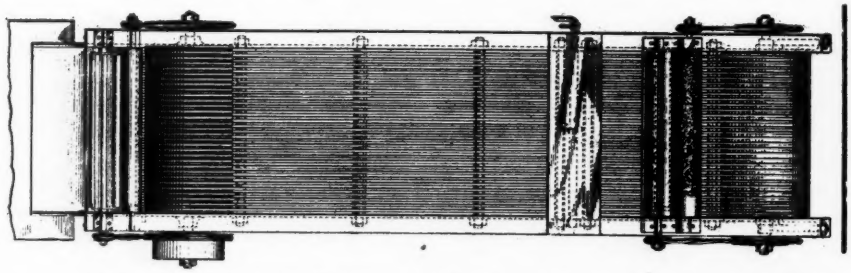
This, however, did not bring about the longed-for advance in prices and profits, as competition continued exceedingly keen. Many orders were filled without profit, and many times goods were sold for less than the cost of production.

The reason for this is to be found in the efforts of the great electric companies to give as much employment as possible to their plants, which had been considerably extended and enlarged.

Another cause was "the competition arising from the growth of native electric industries in many foreign countries which heretofore had been profitable markets for German electric goods. The strong efforts made by these domestic electrotechnical works to crowd out German supplies compelled German exporting concerns to offer exceedingly low terms in order to maintain their footing in these foreign countries. The high price of raw materials was also an obstacle under the above noted business conditions. The prices of some of the raw materials advanced toward the close of the year; among these were copper, brass and dynamo wire. Owing to the establishment of a trust the price of incandescent lamps has been raised fifty per cent."

Electrical Patents.

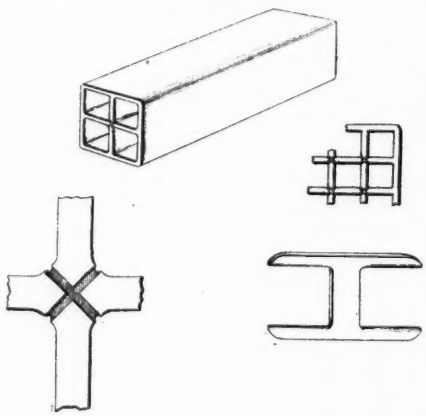
A method of treating pieces of mica or other material to prepare them for adhesive union with each other or with other articles has been devised by Mr. Charles W. Jefferson, of Schenectady, N. Y., and



METHOD OF TREATING MATERIAL TO PRODUCE AN ADHESIVE COATING.

the patents obtained thereon have been assigned to the Mica Insulator Company, of New York, N. Y. In the present invention, each separate piece or scale of mica may be so treated that it can not only be used as a separate insulator of a tough and durable quality and be transported without danger of breaking or other injury or of becoming united together by adhesion, but will also be in condition for adhesively uniting it to other pieces or scales without the addition of any other material. The method, broadly stated, consists in subjecting the scales or pieces of mica to a falling adhesive substance in a finely divided state. The coated pieces or scales are then individually subjected to the action of heat, whereby the surface of each piece will be independently covered and the material melted. The adhesive is then dried and each piece or scale is finally deposited by suitable means separately with their coated surfaces uppermost, so that they may be independently handled in further operations. The inventor has thoroughly protected this idea by a series of patents covering the method and mechanism for carrying out the method and articles as produced.

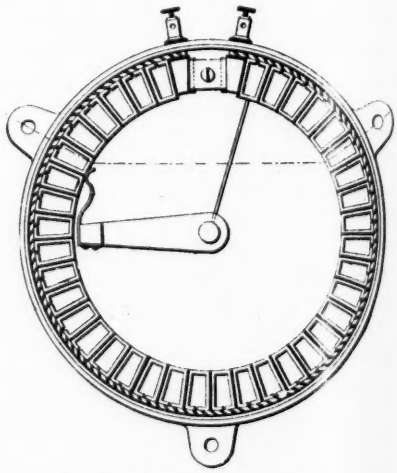
A method of joining sections of underground conduits for electric cables has been recently patented by Mr. James M. Graves, of Brazil, Ind., the object of the invention being to effect an improvement in the means of joining the abutting ends and securing an alignment of the ducts as well as a close fitting of the sections, so that when joined there will be no space between the abutting ends and the sections will be held securely square with one another. In carrying out the invention, a conduit section made of clay is employed, preferably containing four ducts and of rectangular form. In each inner portion of the several ducts, on both ends of the conduit, is formed a short groove or depression which recedes longitudinally from the end of the conduit section, preferably a distance of about one inch. Crossing each other and meeting exactly with the groove or depression are two lateral grooves or depressions in the ends of the sections at the cross web. They may be formed by means of a die or any well-known method which will cause them to be accurate, and thus cause the ducts of the sections to perfectly align with the improved tenon. The conduit tenon is of such shape and dimensions that it will slip snugly into the grooves or depressions,



METHOD OF JOINING SECTIONS OF UNDERGROUND CONDUIT.

that is, a body portion is provided having preferably four prongs projecting therefrom, two on each side, and forming altogether a substantially H-shaped tenon, the inner ends of opposite prongs meeting at similar points in the opposite sides of the body portion and being formed preferably with tapering ends and rounded on the inside and flat on the outside in cross-section for the purpose above noted. Two of the prongs will pass into the grooves or depressions, while half of the body of the clamp will pass into the lateral grooves or depressions. The portion of the tenon projecting from the section thus described will enter the abutting section in the same manner permitting the abutting sections to fit perfectly together and be held securely in alignment. These grooves or depressions are in series so that no matter how the conduit section is placed in the trench it will fit one to the other without turning or adjusting. The grooves or depressions are to be made deep enough so that the clamp will have a firm hold in the section. The improved clamp should preferably be made of metal, its thickness being sufficient to fit the grooves or depressions snugly.

Mr. Charles Wirt, of Philadelphia, Pa., is the inventor of a rheostat, the objects of which are to increase the number of points without a proportionate increase in the cost and by means of which very close regulation can be secured, and to provide means whereby a portion of the heat generated within the resistance will be transmitted to the unused portion of the resistance, so that the temperature of the rheostat as a whole will be equalized. The invention consists in locating the resistance within a cylindrical shell, which may be cheaply made of sheet steel "drawn up" to shape, or of cast or malleable iron. The resistance can be of any well-known form, either strip, plate or sheet, and is laid against the inner surface of the shell with the thinnest possible interposed insulation. The commutator sections are of metal and preferably of T-section, with the head and stem generally at right angles to one another, the bases of the stems engaging with the resistance and the heads separated by short intervening spaces and disposed together to form a path for the traverse of the contact brush. The commutator sections are held in place and in close engagement with the resistance by



NEW FORM OF RHEOSTAT.

having the space occupied by their stems packed with cement or other suitable insulating substance, so that the resistance will be electrically joined to the sections of the commutator and the heads of the latter will form a continuous rim of separated insulated segments. In lieu of

T-shaped sections, the commutator may be formed of box sections with inclined abutting sides. In the present embodiment, the binding material is not necessary, but the segments are forced together and into intimate contact with the resistance by means of an expanding wedge interposed between the periphery of the circle of segments. The separating insulation between the resistance and the outside shell is as thin as possible, and interposed between the insulation and the steel shell is a strip of copper or other good heat-conducting material. By this means the heat generated within that part of the resistance, through which the current is flowing, will pass through the lining of good heat-conducting material and be transferred to the unused portion of the resistance and to that portion of casing which is adjacent thereto.

The World's Fair Souvenir of the Westinghouse Industries.

The Westinghouse Companies Publishing Department has issued in behalf of the joint Westinghouse industries a splendid publication for distribution at the World's Fair, St. Louis. The book describes and illustrates the works and products of the various Westinghouse companies, both in America and foreign countries. The book is handsomely printed and is tastefully bound in an illuminated cover. The interests concerned and from which illustrations have been drawn are: Cooper Hewitt Electric Company, East Pittsburg Improvement Company, Nernst Lamp Company, Pittsburg Meter Company, R. D. Nuttall Company, Sawyer-Man Electric Company, Security Investment Company, the American Brake Company, the Bryant Electric Company, the Perkins Electric Switch Manufacturing Company, the Union Switch and Signal Company, the Westinghouse Air Brake Company, the Westinghouse Foundry Company, the Westinghouse Machine Company, Westinghouse Automatic Air and Steam Coupler Company, Westinghouse, Church, Kerr & Company, Westinghouse Electric and Manufacturing Company, Westinghouse Inter-Works Railway, Westinghouse Traction Brake Company, Canadian Westinghouse Company, Limited; Société Anonyme Westinghouse, France; Société Anonyme Westinghouse, Russia; the British Westinghouse Electric and Manufacturing Company, Limited; the Traction Power and Securities Company, Limited, England; the Westinghouse Brake Company, Limited, England; Westinghouse Electricitäts Actiengesellschaft, Germany.

Western Society of Engineers.

The *Journal* of the Western Society of Engineers for June contains, among other papers, a description of the hydro-electric power development at and near Joliet, Ill. This is by Mr. T. T. Johnston, and shows the development going on at that place.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXXX—ON USING RADIOACTIVE SUBSTANCES IN X-LIGHT AND DERMA-RAY TUBES.

In note CXV, ELECTRICAL REVIEW, February 2, 1901, an X-light tube with a radioactive cathode was described and illustrated, the radioactive substance—impure radium chloride—forming the face of the cathode. In another experiment the radioactive substance was placed in a receptacle and covered with a thin plate of aluminum forming the concave side of the cathode. The object of the experiments was to see if the life of the cathode stream could be prolonged by any property of the radioactive substances; for use increases the resistance of a vacuum tube until the cathode stream does not form. To overcome the resistance hydrogen has been recommended and various methods of operating a hydrogen regulator have been given, the best perhaps being the introduction of the gas through the intermolecular spaces of a palladium tube forming a part of the wall of the vacuum tube. Regulators of this kind have been shown in note l, Fig. 52, ELECTRICAL REVIEW, February 15, 1899; note lxii, Fig. 57, ELECTRICAL REVIEW, April 26, 1899; note lxxxvi, Fig. 68, ELECTRICAL REVIEW, February 7, 1900. Instead of hydrogen radioactive substances were employed, as they continually produce hydrogen by atomic disintegration as well as helium. The radioactive substance used in most of the experiments was radium chloride of an activity three thousand times that of uranium. It was placed in a small tube attached to the X-light tube and held in place by a plug of glass wool. If the rate at which the gas is liberated from the radioactive material is not rapid enough to keep down the resistance of the tube a more rapid escape can be produced by heating. The most practical arrangement for producing this sudden liberation was a modification of the plan described in note cxxxviii, ELECTRICAL REVIEW, May 3, 1902. The radioactive material was mixed with a conducting powder and packed in a tube as shown at HR, Fig. 2, ELECTRICAL REVIEW, December 12, 1903. This tube being placed in shunt circuit allowing the generator used to excite the X-light or derma-ray tube to produce at will the necessary heat in the radioactive substance to liberate sufficient emanation to cause the cathode stream to start, the current then being automatically shut off to prevent the liberation of more emanation than is required. Rutherford's emanation is a heavy gas with a molecular weight of about two hundred. Rutherford having shown his emanation gave rise to the excited activity discovered by the Curies and that the excited activity could be condensed on a negatively charged wire instead of being indiscriminately deposited on all surrounding substances (the wire reaching an activity ten thousand times as great as the thoria from which the emanation arose), experiments were tried in which the cathodes of the X-light tubes containing the radioactive substances were kept charged negatively, when the tubes were not in use, to see if the great condensation of induced activity on the cathodes could prolong the life of the cathode stream. Now that radioactive substances of considerable intensity are easily obtainable these methods may be of sufficient interest to mention.

American Institute of Electrical Engineers.

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Reviews of Current Engineering and Scientific Literature.

The Use of Alternating Currents in Chemistry, and the Theory of the Reactions Which They Bring About.

The chemical reactions brought about by means of alternating currents have been studied by M. Daniel P. A. Berthelot, and some interesting conclusions have been reached. The subject was first taken up by the author in 1897, when he was studying the transformation of sugar into alcohol. The apparatus used consisted of a group of six or eight Bunsen batteries connected to an oscillating commutator, so as to reverse periodically the current through the electrolyzing cell. This current was passed through acidulated water, and the regulating resistance adjusted until no gases were liberated at the electrodes. The electrodes were then introduced into the aldehyde, and the effect noted. It was thought that the simultaneous oxidation and reduction might be compared with fermentation, and that alkali would be formed. To understand the action, consider the case of aldehyde in the presence of air and an alkali. Oxygen plays an electronegative rôle; the aldehyde the electropositive, with a liberation of heat and a change to acid; then perhaps simultaneously the acid acts electronegatively, combining with the electropositive alkali to form a salt, also with the liberation of heat. In this illustration the aldehyde alternates between electropositive and electronegative conditions, and it is such reactions that may be brought about by alternating currents. It will be realized that there are many such. —*Translated and abstracted from L'Éclairage Électrique (Paris), July 9.*

The Electric Lighting of Ladysmith, Natal.

An electric lighting plant has been erected at the town of Ladysmith, Natal. The building is of wood and iron, divided into two parts, one forming the engine room and the other the boiler room. In the boiler room there are two boilers of the locomotive type, each capable of evaporating 2,475 pounds of water per minute at 145 pounds pressure. The fire boxes were especially designed to suit the Natal coal. The engine room contains at present two steam dynamos, each with an output of fifty kilowatts. These sets consist of compound two-crank Willans & Robinson engines, run non-condensing, and directly coupled to two six-pole compound-wound generators, each delivering 137 amperes at 220 volts. These are connected to the opposite sides of the three-wire system. There are two switchboards in the engine room, one for the generators and the other controlling the distributing system. The distributing mains are carried overhead on thirty-foot iron poles, placed forty yards apart. The mains consist mostly of No. 6 standard wire gauge bare copper wire, except in the principal streets, where a stranded wire is used. The streets are lighted by 100 incandescent lamps, each of thirty-two candle-power. At the present time there are about 120 houses making use of this supply. The charges for lighting are on a sliding scale, from one shilling to eightpence per kilowatt-hour. The population of Natal, according to the last returns, was 5,321. Of this number, 2,373 were white. —*Abstracted from the Electrical Review (London), July 8.*

Some Notes on Testing.

While many articles dealing with shop testing have been written, there are, according to "C. H. R. T.", a few convenient and simple tests which are always carried out, but which are seldom mentioned. When a motor is to be tested for speed, it may happen that there is at hand no supply of the proper electromotive force. It may also happen that when a dynamo is to be tested for voltage there is no convenient method of driving it at the proper speed. In the latter case the dynamo may be run as a motor, should there be a suitable supply of power; but should the voltage be too low, the speed of the dynamo or the motor will also be low, and a correction must be made. The correct speed of the dynamo or motor operated in this way will be found from the following formula: $\frac{DS}{MS} = \frac{DV + LV}{MV - LV}$, where DS is the speed of the machine running as a dynamo; MS, the speed at which it will run as a motor on its proper voltage; DV, the voltage generated as a dynamo; MV, the voltage for which the machine is designed; LV, the volts lost in the armature and series field coils, if any. It is more convenient to test the speed of a motor by driving it as a dynamo, but the speed is not exactly right. The same formula will give the speed at which the machine will run upon the proper voltage. Before sending out a compound dynamo or motor, it is desirable that it should be tested to see if all connections have been made properly. The convenient way of doing this is to short-circuit the series winding for a few seconds after the machine has been put in operation. In the case of a dynamo the external current will increase if the series winding opposes the shunt. It will decrease if the machine is correctly coupled. In the case of a motor, the external current of the driven machine will decrease if the machine is wrongly coupled, and increase if it is correct. For these tests the most convenient have supply mains of fairly low voltage—say about 100—in a convenient place, so that all machines above that voltage may run on them. In making this test care must be taken when a high-voltage shunt machine is connected to the low-voltage circuit. When this is done it is frequently necessary to start the machine by hand, owing to the weak field.—*Abstracted from the Electrical Engineer (London), July 8.*

The Condition of Industrial Electrometallurgy.

In this section of a serial, M. J. Izart considers the practical application of the electrolysis of fused salts. It is admitted that, for the present, electric furnaces can not compete with blast furnaces for the reduction of iron ore. There are, however, certain applications where the electric furnace can be applied successfully. In one case only can the electric furnace act as an auxiliary to the blast furnace—that is, in the agglomeration of powdered mineral. To use the ore in the powdered condition in the blast furnace is difficult and dangerous, so that it is necessary to form the ore into briquettes—a costly process. On the other hand, the enormous consumption of iron ore indicates that the day is not far off when material at present discarded must be used. A mineral containing less than fifty per cent of iron is discarded to-day, but, before long, this will have to be employed. To do this some method of concentration will be necessary; but, unfortunately, these concentrates are obtained in the form of a very fine powder, making them unsuitable for the blast furnace, so that briquetting or agglomeration in some way must be adopted. Mechanical agglomeration is costly, but agglomeration by means of the electric furnace—such as that developed by Ruthenburg—seems to solve the problem.

The production of steel electrically is, however, on a different basis, since here there are a number of important advantages incident to the use of the electric furnace. This is particularly true when certain grades of steel, such as nickel or chrome steel, are desired, as the percentage of the material can be controlled, and the introduction of other materials not desirable can be avoided. These remarks also apply to the manufacture of alloys of iron, where it is important to be able to produce a perfectly defined material. There are a number of installations in operation to-day producing various qualities of steel and iron alloys in the electric furnace. Among these may be mentioned the Praz station in France, where the Héroult system is in operation; and the Gysinge station in Sweden, using the Kjellin process. In Germany the Gin process will be put into operation at Verdahl and at Westphalia, and in Italy Stassano is trying a system at Turin.—*Translated and abstracted from L'Industrie Électrique (Paris), July* 10.

The New Two-Phase Station at Sheffield, England.

The electrical supply system at Sheffield, England, is one of the oldest in the United Kingdom. The Sheffield Electric Light and Power Company was formed in 1892, although for some years previous to this light had been supplied from a factory to outsiders. In 1897 the corporation bought the works from the company, and in 1900 it was decided to change over to a two-phase system. The old generators have been rewound, and new works at Neepsend have been erected. A special feature of this station is the arrangement of boilers and furnaces, a regenerative system of induced draught being employed, from which considerable economy is anticipated. The coal-handling apparatus is very complete, each charge of coal being weighted automatically and registered. It is impossible for the attendant to obtain coal without this registration. The boiler equipment consists of two Stirling boilers, each with a superheater, with a capacity of 30,000 pounds of steam per hour, and a guarantee of eighty per cent efficiency. Two more of the same type have been ordered. Each boiler is fitted with Bennis quadruple machine stokers and compressed-air furnaces. Each is arranged with strong cast-iron side bars and seven compressed-air bars. The Ellis & Eaves system of induced draught has been employed. The flue gases are drawn from the boiler by a fan passing through a group of 423 two and three-quarter-inch air-heating tubes on their way to the fan and the chimney. The air supply passes around the tubes, and there are long, flat air ducts at the side of each boiler. Part of the air passes into the furnace between the bars of the Bennis stoker, while part is led into the boiler at the side near the back of the furnace. The air here passes into the furnace through twenty-four three-inch by two-inch openings. The fan for each boiler is capable of dealing with 45,000 cubic feet of air per minute. It is driven at 580 revolutions per minute by a thirty-horse-power two-phase motor, the motor being provided with a speed-regulating rheostat. Each boiler is connected by means of a seven-inch wrought-steel lap-welded steam main, with bends of large radius, to a 1,500-kilowatt Parsons turbine. These turbines run at 1,500 revolutions per minute, and take steam at 150 degrees superheat. They are directly coupled, through flexible couplings, to the two-phase alternators. Each set has its own surface condenser. The circulating and air pumps are motor driven, the speed of the motor in all cases being regulated by resistance in the rotor circuits. Oil channels, through which the lubricating oil for the turbines is passed, are located in the basement. A high-tension switchboard has been erected on a gallery, to which the concentric distributing cables are brought. One concentric cable is used for each phase. The engine room has been supplied with a traveling crane operated by hand, which can be converted to an electric crane if desired. Distribution is made to a number of substations at 2,200 volts.—*Abstracted from the Electrician (London), July* 8.

Some New Rectifying Effects in Conducting Gases.

The manner in which electricity passes from a metal to a gas, or from a gas to a metal, is not well understood. An investigation was therefore undertaken by Mr. P. G. Nutting, to determine what conditions of the metal or the gas favored the transfer of electricity from one to the other. At the same time it was sought to obtain some light on the mechanism of surface condition. The results of his first work while somewhat crude, have a direct bearing on the theory of metallic gas conduction. If an alternating current of a maximum voltage just a little above the maximum total drop in potential between electrodes be employed to send a current through a gas, conditions can not change appreciably between successive alternations, and the excess of current in one direction may be taken as a rough measure of the relative surface conductivity at the two electrodes. It is hardly conceivable that there can be any rectifying effect, due to the gas itself, away from the electrodes, as this would require a fixed orientation of these particles; hence, rectification may be regarded as due to conditions existing at the metal gas surface and in the immediately adjacent metal and gas. Most of the work is done with Plücker tubes, slightly altered according to the conditions desired. A direct-current Weston milli-ammeter measured the rectifying current, and an alternating-current voltmeter gave the total current. Rectification as small as half of one per cent could be easily measured. The following effects were noticed: if there is a difference in pressure in the gas about the two electrodes, a rectifying current will pass from the point of high pressure to that of low pressure. If oxidation around the low electrode is sufficiently complete, rectification takes place. If one electrode be larger than the other, rectifying current will pass from the small to the large. When the large electrode is three times the size of the smaller, a rectification of twelve per cent is observed. The difference of temperature between the two electrodes causes a rectifying current to pass from the hot to the cold. When one tube is heated to about 250 degrees, and the other kept cold by means of a wet cloth, a rectification of twenty-five per cent is obtained. If one bulb of a Plücker tube is filled with mercury vapor, and the other with air or hydrogen, there is a decided rectifying effect from the mercury vapor toward the hydrogen. The condition of the surface of the electrodes appears to determine a slight but decided rectifying effect, the current passing from the smooth to the rough. With one mercury electrode and the other of iron of the same size, there is but a slight rectifying effect from mercury to iron on starting the current. After the current has been running for some time, the mercury vapor over its electrode tends to increase the rectification, while the much hotter iron electrode tends to decrease it. It will appear from this that the action of the Cooper Hewitt rectifier on a three-phase circuit is largely due to the much greater surface exposed by the mercury electrode and the greater density of mercury vapor in its immediate neighborhood. The author also discusses the shape of the current wave passing through the tube.—*Abstracted from the Physical Review (Lancaster, Pa.), July.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Sprague-General Electric Type M Control System.

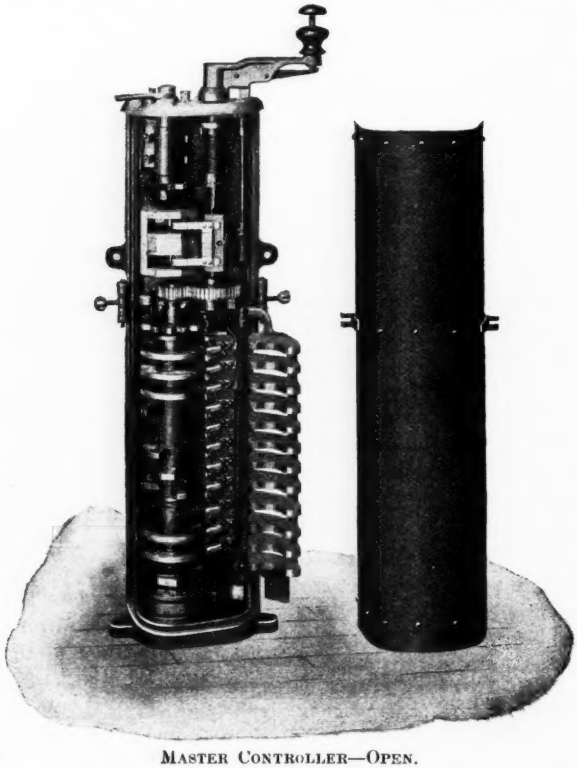
The Sprague-General Electric type M control is designed primarily for the operation of a train of motor or trail cars, coupled in any combination and the whole operated as a single unit from any controller on the train. The system may also be used to advantage on individual equipments and locomotives.

The control apparatus for each motor car may be considered as consisting essentially of a motor controller and a master controller.

The motor controller comprises a set of apparatus—usually located underneath the car—which handles directly the power circuits for the motors, connecting them in series and parallel and commutating the starting resistance in series with them. This motor controller is operated electrically, and its operation in establishing the desired motor connections is controlled by the motorman by means of the master controller which is similar in construction to the ordinary cylinder controller and is handled in the same manner. Instead of effecting the motor combinations directly, however, this controller merely governs the operation of the motor controller.

The master controller operates a number of electrically operated switches, or "contactors," which close and open the various motor and resistance circuits, and an electrically operated "reverser" that connects the field and armature leads of the motors to give the desired direction of movement to the car. Both the contactors and reverser are operated by solenoids, the operating current for which is admitted to them by the master controller.

Each motor and trail car is equipped with train cable, consisting of nine or ten individually insulated conductors connected to corresponding contacts in coupler sockets located at each end of the car. This train cable is connected identically on each motor car to the master controller fingers and the contactor and reverser operating coils, and is made continuous throughout the train by couplers between cars, connecting together corresponding terminals in the coupler sockets.



MASTER CONTROLLER—OPEN.

All wires carrying current supplied directly from the master controller form the "control circuit"; those carrying current for the motors form the "motor" or "power circuit."

Inasmuch as the motor controller operating coils are connected to this control train line, it will be appreciated that energizing the proper wires by means of any master controller on the train will simultaneously operate corresponding contactors on all the motor cars, and simultaneously establish similar motor connections on all cars.

The Sprague-General Electric type M control permits a train of motor cars and trailers to be operated as a single unit from any master controller on the train. If desired, a master controller can be placed on each platform of trail cars, thereby providing for the operation of the train from any platform. With this arrangement, the motorman can be always at the head of the train, regardless of the combination of the cars.

The entire train with type M control may thus be regarded as a unit; the motorman has the same control over a train that he would have over a single car with the ordinary cylinder controller.

Should the motorman remove his hand from the operating handle of the master controller, the current will be immediately cut off from the entire train, thus diminishing the danger of accident in case the motorman should suddenly become incapacitated.

The system will operate at any line potential between 300 volts and 600 volts, and the action of all contactors is absolutely reliable and instantaneous.

On heavy equipments the effort of the motorman in operating the master controller is so much less than that required to handle a large cylindrical controller that he can give more attention to the air brakes and other parts of the equipment, especially in cases of emergency. The ease with which it is operated also makes the type M control particularly well suited for use on large locomotives.

The approximate total weight per motor car of control equipments, exclusive of supports, is as follows:

Aggregate Horse-Power of Motors.	Weight of Equipment in Pounds.
100	1,500
200	2,000
300	2,500
500	4,000
640	4,500

The approximate weight of the appara-

tus for each trail car, which comprises train cable, coupler sockets and connection boxes, is 100 pounds.

In many cases it will be found advantageous to anticipate the future growth of an interurban road by equipping each motor car with type M control. In these cases it will be easy to change from single car to train service whenever warranted by traffic conditions.

The position of the handle on that master controller which the motorman is operating always indicates the position of the motor control apparatus on all cars.

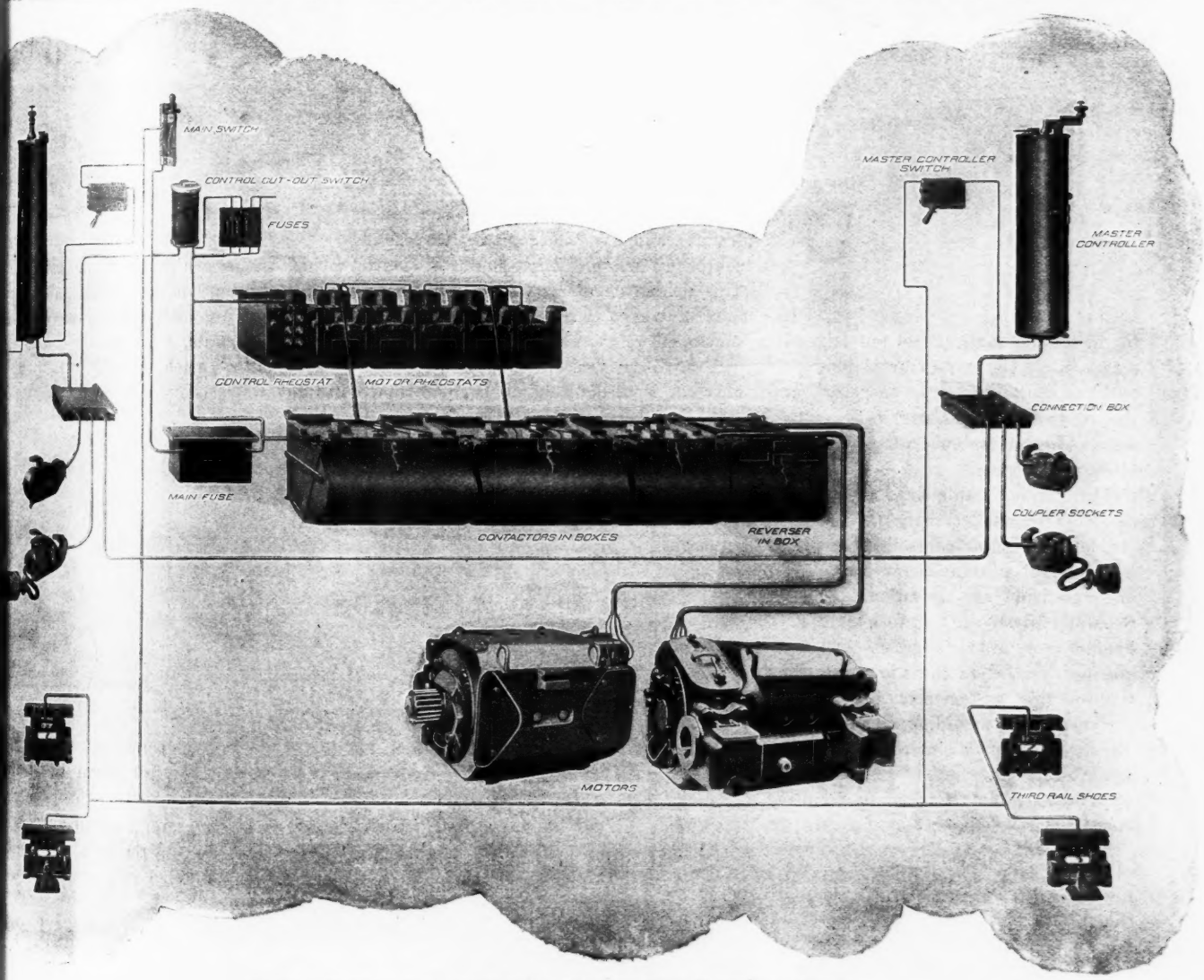
The contactors are the means of cutting in and out the various resistances, of making and breaking the main circuit between trolley and motors, and of changing from series to parallel connection.

Each contactor consists of a movable arm carrying a renewable copper tip which makes contact with a similar fixed tip, and a coil for actuating this arm when supplied with current from the master controller. The contactor is so designed that the motor circuit is closed only when current is flowing through its operating coil; and gravity, assisted by the spring action of the finger, causes the arm to drop and open this circuit immediately, when the control circuit is interrupted. Each contactor has an effective and powerful magnetic blow-out, which will disrupt the motor circuit under conditions far exceeding normal operation. In closing, the copper tips come together with a wiping action, which cleans and smooths their surfaces.

All contactors in an equipment are practically identical, and the few parts which are subject to burning and wear are so constructed as to be readily replaceable.

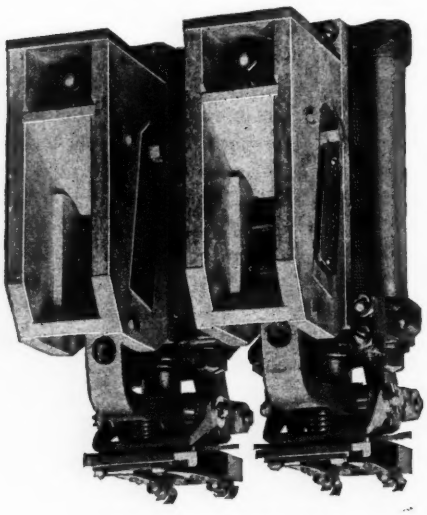
In order to save space and eliminate interconnections as much as possible, several contactors are mounted on the same base. The contactors should preferably be located under the car, and boxes are therefore supplied which facilitate installation, protect the contactors from brake-shoe dust and other foreign material, and provide the necessary insulation. These boxes are built with perforated openings for ventilation, but shields are supplied for closing these perforations whenever desirable.

The general design of the reverser is somewhat similar to the ordinary cylindrical motor reversing switch with the addition of electromagnets for throwing it to either forward or reverse position. In general construction, the operating coils are similar to those used on the contactors, but in order to secure absolute reliability of action in throwing, the coil is given full line potential. The reverser is provided with small fingers for handling control circuit connections, and when it throws, the operating coil is disconnected from ground and is placed in series with a set of contactor coils, thus cutting the operating current down to a safe running value. These coils are protected by a fuse, which



General View of Sprague-General Electric Type M Control System.

will immediately open the circuit if the reverser fails to throw. If the position of the reverser does not correspond to the direction of movement indicated by the

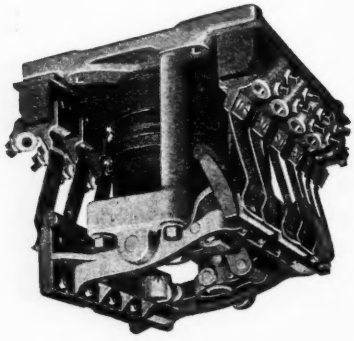


CONTACTOR.

reverse handle on the master controller, the motors on that car can not take current. While the motors are taking current the operating coil is energized, and the electrical circuits are interlocked to prevent possibility of throwing.

The master controller is considerably smaller than the ordinary street car controller, but is similar in appearance and method of operation. Separate power and reverse handles are provided, as experience has led to the adoption of this arrangement in preference to providing for the movement of a single handle in opposite directions.

An automatic, safety, open-circuiting device is provided whereby, in case the



REVERSER.

motorman removes his hand from the master controller handle, the control circuit will be automatically opened by means of auxiliary contacts in the controller, which are operated by a spring when the button in the handle is released. This device is entirely separate and distinct in its action from that of the main cylinder. Moving the reverse handle either forward or backward makes connections for throwing the reverser to either forward or backward position. The handle can be removed only in the intermediate or off position. As the power handle is mechanically locked against movement when the reverse handle is removed, it is necessary for the motorman to carry only this handle when leaving the car.

When the master controller is thrown off, both line and ground connections are severed from the operating coils of important contactors, and none of the wires in the train cable is alive.

The current carried by the master controller is about 2.5 amperes for each equipment of 400 horse-power or less. This small current-carrying capacity permits a compact construction, and the controller weighs only 130 pounds.

A small enclosed switch with magnetic blow-out is used to cut off current from each master controller, and is supplied with a small cartridge fuse enclosed in the same box. When this switch is open all current is cut off from that particular master controller which it protects.

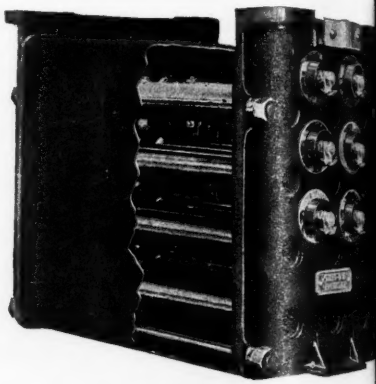
CONTROL COUPLER SOCKET.

A special flexible cable, made up of different colored individually insulated conductors, is used for the train cable and, whenever possible, to make connections between the various pieces of control apparatus.

Connection boxes are provided for connecting the control circuit cables at junction points without splicing, and small copper terminals are supplied for attaching to the ends of the individual conductors.

The master control cables of each car terminate in sockets and are interconnected by means of a short section of similar flexible cable fitted with plugs. Each socket contains a number of insulated, metallic contacts connected to the train wires, and the terminal plugs of the train contain corresponding contacts. The parts subject to wear are readily replaceable.

All coupler sockets are provided with



CONTROL RHEOSTAT.

spring catches which hold the plugs in contact under normal conditions, and permit them to automatically release in case two cars separate.

There is a switch, usually nine-point, installed on each motor car which is used to disconnect the operating coils of the contactors and reverser from the train cable, and hence render them inoperative.

On each car several small enclosed fuses are placed in the control circuit at such points as to effectively protect the apparatus.

During acceleration, tubes of a high resistance rheostat are connected in series with the contactor coils to cut down the operating current to a value approximating that for the running positions of the controller. This rheostat is enclosed in a sheet-iron case for protection.

The motor circuit is local to each car and on the first point the current on entering from the trolley or third rail shoe passes through the following pieces of apparatus in the order named: main switch and fuse, contactors, resistances, reverser, motors; thence to ground.

In the control circuit the course of

the current from trolley to ground is through the master controller switch and fuse, master controller, connection box, to the cutout switch. From the cutout switch the current passes through the control cable to the operating coils of the reverser and contactors, and thence through fuses to ground.

Chain Block Exhibit of the Yale & Towne Manufacturing Company.

The accompanying illustration shows a view of the chain block exhibit of the Yale & Towne Manufacturing Company, New York city, at the World's Fair, St. Louis. The company has spared no pains to make its exhibit interesting to the casual man, as well as to the engineering student, and it is attracting considerable attention. There are shown blocks of all three types, from one-eighth-ton to twenty tons capacity. The most interesting part of the exhibit is the moving hoist. Here is shown in operation the new electric hoist, and there is also one each of the company's triplex, duplex and differential blocks, operated by electric motors, for the purpose of showing their relative efficiencies. Each block is supplied with a 1,000-pound weight, so arranged that

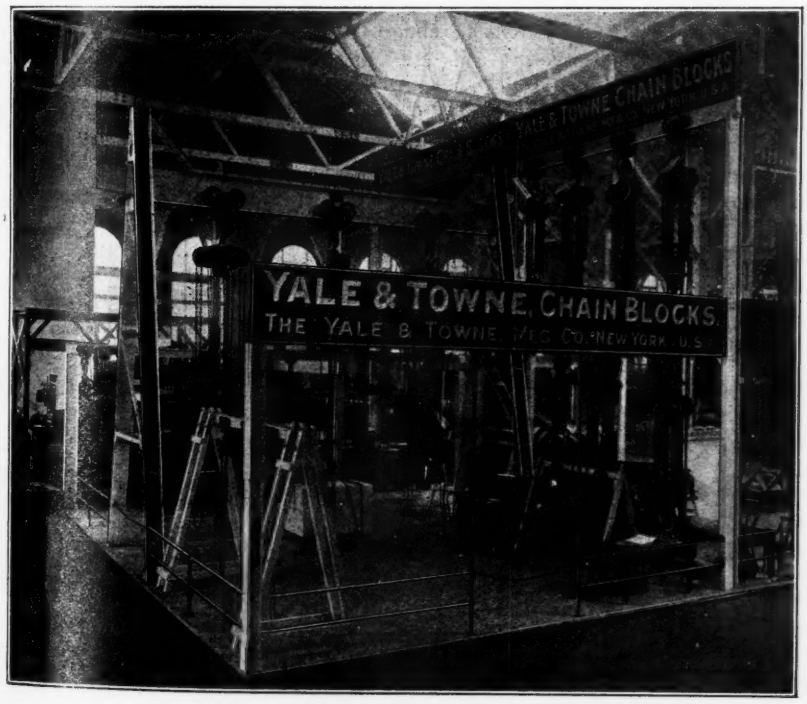


EXHIBIT OF THE YALE & TOWNE MANUFACTURING COMPANY, NEW YORK, AT THE WORLD'S FAIR.

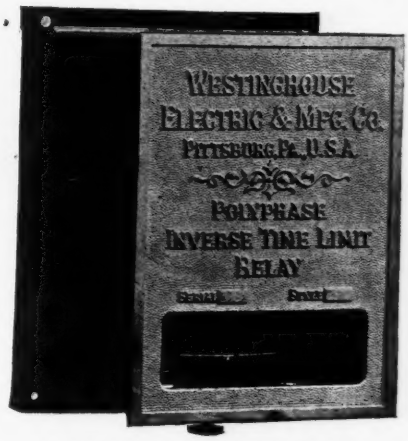
equal power is applied to each block. The result is that the triplex block lifts its load quicker than the others, while, at the same time, the ammeters show equal power applied to each block. The mechanism is automatic, so that when the triplex weight arrives at the top, all three blocks reverse their motion and lower their weights until all reach the floor, when they again automatically reverse and begin to hoist.

A New Inverse Time Limit Relay.

The accompanying engraving illustrates a new inverse time limit relay announced by the Westinghouse Electric and Manufacturing Company. It is made in types for both single and polyphase circuits, the single-phase relay containing one electromagnet with its regulating mechanism and the polyphase type consisting essentially of two single-phase mechanisms in a case and properly connected.

The electromagnet consists of two coils connected in series with a series transformer and having a U-shaped laminated iron core, from which the moving contact is suspended. When an overload occurs, the core is drawn into the coils raising the moving contact until connection is made with the stationary contact and the tripping circuit is closed.

The variable time element is supplied by an air check, which is connected by a vertical rod. As the core and moving contact rise, the air in the checking chamber is compressed and acts in the same manner as a dashpot in retarding the closure of the circuit. An intake valve allows the checking chamber to fill quickly when the overload is removed, and the relay is thus automatically reset. The outlet valve furnishes the inverse time limit feature, as the ball which closes the valve is held lightly under the compression of a coiled spring, the amount of the pressure upon the valve from within regulating the size of the opening. When a slight overload occurs, the pressure upon



A NEW POLYPHASE INVERSE TIME LIMIT RELAY.

the check is light and the air escapes slowly through a small opening. In the event of a short-circuit, the magnet core would be drawn rapidly upward, the air being expelled quickly from the valve which the pressure would force wide open, and the tripping circuit would be closed. The effect upon the time limit varies with the amount of overload, the length of time being in inverse proportion to the excess of current. Should the overload cease before the contacts touch, the magnet core drops to its original position and the relay is reset. The simplicity of this arrangement ensures its perfect action under all conditions and permits a sturdiness of construction not always found in conjunction with so sensitive and delicate an operation.

Adjustments are provided covering a wide range in time and current. The stationary contacts can be raised or lowered, thus varying the distance traversed by the moving contacts. Both the intake and the outlet valves of the air check are adjustable, thus controlling the speed with which it is emptied and filled. The leverage of the counterpoises attached to the check is also subject to adjustment, and by means of weights placed upon the scale pan beneath the magnet the weight of the moving element is increased.

The construction throughout is the best and, in all respects, the maker states this relay is a high-grade instrument, which will give successful service under the most exacting conditions.

Round-Type Motors for Direct Current.

The accompanying illustrations show several details of the patented single-field-coil round-type motors which the Sprague Electric Company, New York city, has placed in satisfactory service for a number of years throughout the country. These motors have a high efficiency and

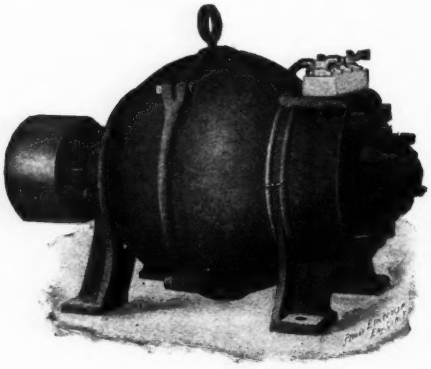


FIG. 1.—ENCLOSED ROUND-TYPE MOTOR.

remarkable endurance, and their design and construction make them universally adaptable. The motors have a strong torque, and are non-sparking and compact. They can be wound for a wide range of speeds and voltages, and either shunt, series or compound. They may be operated either as open or enclosed motors, making them practically moisture and dust-proof, when so required. Fig. 1 shows an enclosed motor, Fig. 2 showing the round-type motor with one door open.

Fig. 3 shows the half-yoke and pole-piece of the round-type motor. The field frame is a steel casting made in two similar parts, each part carrying one pole-

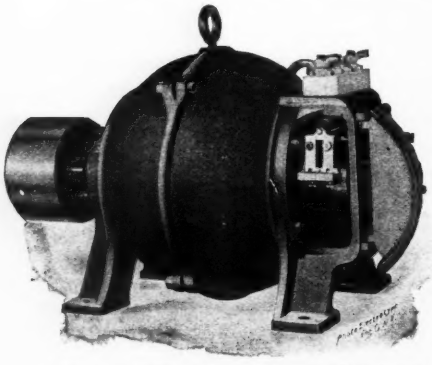


FIG. 2.—ROUND-TYPE MOTOR—ONE DOOR OPEN.

piece. These two parts enclose the field coil, which is a single coil energizing both pole-pieces. The pole-pieces are cast in one piece with the field yoke, giving them solidity and security. In the magnetic circuit there is but one joint, and that is where the two half field yokes are connected.

Fig. 4 shows the round-type field coil. The single-field coil employed in these motors is a distinctive feature. This single coil surrounds and energizes both pole-pieces simultaneously and directly, shortening the magnetic circuit and reducing leakage to a minimum. The field coil is wound on a former, and is thor-

FIG. 3.—HALF YOKE AND POLE PIECE OF ROUND-TYPE MOTOR.

oughly insulated and taped. The armature is of the ironclad type, with slots or grooves in its periphery, in which the armature conductors are placed and held securely by rigid retaining wedges. The armature core consists of laminations of soft annealed sheet-steel punchings, thoroughly japanned. The insulation in the slots and on the coils is reliable and moisture-proof. The armature coils are

FIG. 4.—ROUND-TYPE FIELD COIL.

made of pure copper of high conductivity. The design and construction of the commutator is to the end that perfect commutation will result. The commutator is of relatively large size and has a liberal number of segments. These are of the best hard-drawn copper, insulated from each other and from the shell by mica. The commutator and brushes are accessible at all times by side doors, and may be left open or enclosed, as occasion may require.

Fig. 5 shows the brush-holder used with

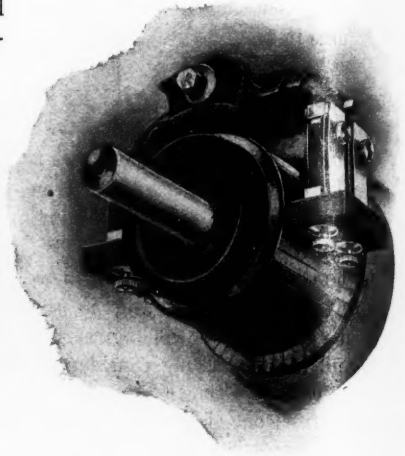


FIG. 5.—ROUND-TYPE BRUSH-HOLDER.

this type of motor. The carbons are held parallel with the commutator segments during the entire life of both. They are noiseless, cool running and can be used with the motor operating in either direction. The entire surface of the commutator bars is utilized by the carbons abutting each other.

The bearings are of the self-aligning and self-oiling ring type. The motors are made in sizes from one-quarter to twelve horse-power, and are wound as standard machines for 115, 230 and 500 volts.

Fig. 6 shows a sectional view of the round-type motor. These motors have been in popular demand for years, their

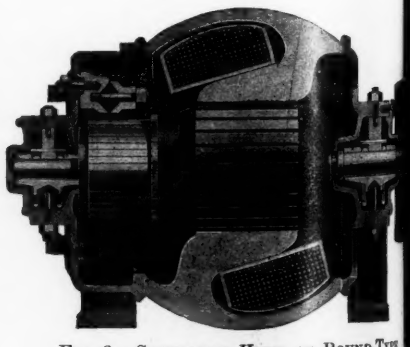


FIG. 6.—SECTIONAL VIEW OF ROUND-TYPE MOTOR.

design and construction enabling them to operate delicate mechanisms or drive heavy or cumbersome machines with economy and precision. The facility with which they may be connected to the machine itself, or attached to the floor, wall or ceiling, or run in a vertical position when so ordered, increases their popularity.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

A NEW CABLE COMPANY—A company has been formed in Cologne, Germany, with a capital of $1,750,000, subsidized by the German and Dutch governments, to lay a cable to connect with the Dutch settlement on the island of Celebes through the island of Yap in the Pelews group, and from Shanghai to Guam, where it will connect with the Commercial Cable Company's Pacific cable.

MERGER OF OREGON TROLLEY COMPANIES—Negotiations are being completed for the merger of the City & Suburban Company and the Portland Railway Company, the two large competing street railway companies of Portland, Ore. These railways have an aggregate of 112 miles of track. The property of the City & Suburban Company is valued at $2,500,000, and that of the Portland company at $1,500,000.

NEW POWER PLANT IN SOUTH CAROLINA—Arrangements have been completed ensuring the establishment of a large electric plant at Belton, S. C. The project will be under the management of the Belton Power Company, which has been organized recently. The company will develop from 4,500 to 5,000 horse-power on the Saluda river, and transmit it to Williamston. It will also furnish electric lighting and water to the town of Belton, S. C. The initial capital is $100,000.

CHICAGO SUBWAY PLANS—A site for a general terminal of the Illinois Tunnel Company's system of underground electric railways has been secured by the company at a cost of $2,500,000, through the purchase of property on the west bank of the Chicago river. On this site there will be built a general distributing system for the transportation of freight between stores and warehouses and the steam railroads. The company's power plant will also be built at this place.

MORE POWER FROM NIAGARA FALLS—It is announced that a number of eastern capitalists have taken up the old Love charter, granted in 1891 to the Niagara County Irrigation and Water Supply Company, and intend to invest $9,000,000 in developing a new power scheme. The charter permits the company to take unlimited quantities of water from the river above the falls, and to develop power at any point desired in the lower gorge. Large tracts of land have been bought in connection with the original scheme, but it is stated that the development of power will be the chief object of the company.

TO DEVELOP NEW DOMINION WATER POWER—A company has been organized in Winnipeg, Manitoba, to develop the Silver falls on the Winnipeg river. The company has been incorporated under the name of the Manitoba Water-Power Electrical Company, and the capital is said to be $5,000,000. The officers are: Hon. H. J. McDonald, president; Sir Daniel McMillan, vice-president, and the Hon. R. P. Roblin, secretary-treasurer. Silver falls is a series of three cascades, giving a total fall in the neighborhood of thirty feet. A number of streams enter the river just above it, so that more water passes over this fall than any other in the Winnipeg river.

THE NEW POWER-HOUSE OF THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD—Plans have been filed with the building department of the Borough of the Bronx for the construction of a large power-house for the New York Central & Hudson River Railroad. The building will be located on 149th street, ninety-five feet west of Long Island Sound. According to the plans, the structure will be three stories high, 236 feet long and 167 feet wide, and will cost about $500,000. The superstructure will be of granite, brick and terra-cotta, while the framework will be of steel. C. W. Smith, the architect for the railroad company, will have charge of the work. The contract for the foundation, which is to be of concrete, has been awarded to E. C. Weeks & Son, and work has been begun. Bids for the superstructure, which will be started as soon as the foundation is finished, are yet to be considered. When completed, the power-house will contain the machinery which will furnish electricity with which to run the trains through the Central tunnel, to and from the Grand Central station and as far north as the Bronx river.

LARGE CONTRACT FOR ELECTRICAL MACHINERY—It is said that the Allis-Chalmers Company has secured a contract for electrical machinery which will call for the expenditure of some $2,000,000. The contract is reported to have been awarded by Thomas E. Murray, acting as consulting engineer for the Brooklyn Rapid Transit Company, the New York Edison Company and a number of other companies in which Mr. Anthony N. Brady is one of the dominant factors. There will be six 5,500-kilowatt turbines, direct-connected to twenty-five-cycle, 750-revolutions-per-minute, three-phase, alternating-current generators. The latter machines will be wound to give either 6,600 or 11,000 volts. One of these units is to be installed in a large power-house which the Brooklyn Rapid Transit Company is erecting at Kent and Division avenues, Brooklyn, N. Y. It is estimated that this power-house will contain almost 100,000 horse-power in machinery. Twelve turbines in all are to be put into the plant. This statement has been contradicted, according to press statements, by President Winter of the Brooklyn Rapid Transit Company.

TELEPHONE AND TELEGRAPH.

KENDRICK, IDA.—The Inland Telephone Company will extend its line to this place.

ORLEANS, IND.—The Hoosier Telephone Company is now rebuilding its system in this town.

PORTLAND, ME.—The Automatic Telephone Company has been granted a franchise by the city council.

SALT LAKE CITY, UTAH—The Independent Telephone Company has opened its new building in this city.

SIOUX CITY, IOWA—The Sioux City Telephone Company has let contracts for a new building to cost $25,000.

WOODSTOWN, N. J.—A meeting has been held in the interest of a rural line, and it is expected that a company will shortly be organized.

MONTROSE, PA.—The Tunkhannock & Wyoming Valley Telephone Company is installing a 200-drop switchboard in its Tunkhannock exchange.

LEAVENWORTH, KAN.—The People's Telephone Company is preparing to expend about $70,000 in equipping its system in this city with new apparatus.

CRANBROOK, BRITISH COLUMBIA—The Cranbrook Electric Light Company, which operates the telephone lines in this district, is preparing to extend the system to Moyie and Wardner.

STILLWATER, MINN.—Work has been commenced by farmers on a rural line running south of Stillwater. It is stated that practically all the farmers between this city and Afton will become subscribers.

WICHITA, KAN.—It is reported that the Missouri & Kansas Telephone Company has formulated plans whereby it is to install an entirely new local system in the city of Wichita, and that work will begin shortly.

NORWALK, OHIO—The American Telephone and Telegraph Company has made preparations to build a new long-distance line from North Baltimore to Norwalk, connecting at the latter place with the company's main long-distance lines.

HASTINGS, NEB.—The city council has granted a thirty-year franchise to the Hastings Independent Telephone Company, reserving the right to purchase the company's property at the end of ten years at an appraised valuation to be determined upon by designated citizens. Wires in the business portion of the town will be placed underground.

ELECTRIC LIGHTING.

HEALDSBURG, CAL.—The annual report of the municipal lighting plant and waterworks shows a net profit to the city of $5,988.32.

LANSING, MICH.—Improvements costing $20,000 are to be made to the city lighting system.

TRAVERSE CITY, MICH.—The plan of installing a municipal lighting plant in connection with the waterworks is being considered.

LAKE CITY, IOWA—The Lake City electric light plant, which is controlled by local capital, has been leased for a term of years to Otto E. Brownell.

GENEVA, N. Y.—It is reported that plans are under way for the consolidation of the electric lighting plants of Geneva, Waterloo, Seneca Falls and Auburn.

McKEESPORT, PA.—An ordinance has been passed authorizing a special election on the question of a $125,000 bond issue for a municipal electric light plant.

STURGIS, S. D.—The Sturgis electric light plant, which furnishes light for this city and Fort Meade, has been enlarged by the addition of two 200-horse-power boilers.

HOPKINSVILLE, KY.—Articles of incorporation of the Pembroke Light, Power and Water Company have been filed with the county clerk. The capital stock is $20,000.

MILTON, FLA.—A franchise has been granted to the Milton Electric Light Company to erect and maintain poles and wires within the city limits. Construction is to begin within five months.

YORK, PA.—Work on the new power plant at York Haven has progressed so rapidly that there is a possibility of its being completed about August 15, instead of in September, as had been previously planned.

BEVERLY, MASS.—The Beverly Gas and Electric Company has installed three new 150-kilowatt generators of the General Electric make and a new switchboard. A twenty-four-hour service is furnished, the company lighting Manchester-by-the-Sea in addition to Beverly.

SAN FRANCISCO, CAL.—There has been placed on record a deed of trust by which the Mutual Electric Light Company transfers to the Mercantile Trust Company, of San Francisco, all its real and personal property as security for the guaranteeing of an issue of $400,000 worth of five per cent thirty-year gold bonds.

SHELBY, MICH.—This village is considering the advisability of either shutting down the municipal electric lighting plant or raising the rates so as to put the plant on a self-supporting basis. It is possible that the outcome of the matter may be the issuing of bonds for the installation of a complete new plant, the present one being inadequate to supply the needs of the village.

GLADSTONE, MICH.—Extensive improvements to its plant are being planned by the Electric Light and Power Company, of Manistique. The plant is to be materially enlarged, so that new industries locating in this city can be supplied with power. Fifty thousand dollars will be spent for the purpose. The energy utilized is secured from the river, which is harnessed near the point at which it empties into Lake Michigan.

ALBION, N. Y.—The Albion Electric Light, Power and Gas Company has elected the following directors and officers for the ensuing year: Directors—Hon. Frank A. Dudley, Wallace C. Johnson, Niagara Falls; Bird W. Spencer, William Young, Passaic, N. J.; Lucian H. Tyng, Buffalo; Frederick W. Cole, Poughkeepsie; Sanford T. Church, Albion. Officers—president, Bird W. Spencer; vice-president and general manager, W. C. Johnson; treasurer, L. H. Tyng; secretary, S. T. Church.

BALTIMORE, MD.—The county commissioners have closed a contract with the Mount Washington Electric Light and Power Company for furnishing electric lights for public highways at Mount Washington, Arlington, Govanstown, Towson, Lutherville, Pikesville, Glyndon and Reisterstown. The contract is for five years, and the company is allowed $35 per year for light of sixty-candle-power and $25 per year for thirty-two-candle-power lights, to be kept burning on nights when the moon is not shining. The company is allowed $42 per year for lights of sixty candle-power and $36 per year for lights of thirty-two candle-power, to be burned all night. A contract has also been closed with the Mount Washington Electric Light and Power Company. The company is allowed $99.92 per year for furnishing all-night arc lights at the villages of St. Denis and Catonsville.

WASHINGTON, D. C.—At the annual meeting of the stockholders of the International Motor and Power Company the following trustees were elected: Hopewell H. Darneille, Washington; Samuel W. Smith, M. C., Pontiac, Mich.; Charles F. Joy, St. Louis, Mo.; Jacob H. Gallinger, of New Hampshire; Alexander H. Bell, Washington; William L. Walter, Port Huron, Mich.; Frank W. Bartlett; Edgar Weeks, Mount Clemens, Mich.; B. H. Brockway, Washington; Henry L. Biscoe, Washington; Tompkins C. Delavan, New York city; Charles H. Fred, J. S. Ziegler, S. H. Bell and Francis Nye, of Washington.

SARATOGA SPRINGS, N. Y.—The annual meeting of the stockholders of the Mechanicsville Electric Light Company was held recently, when these directors were elected: James Greenaway, M. F. Farrow and Edwin Farron. The directors elected the following officers: president and treasurer, Edward Farron; vice-president, James Greenaway; secretary, M. J. Farron. The Halfmoon Heat, Light and Power Company's stockholders have elected these directors: J. C. Duncan, H. O. Bailey, W. L. Howland, E. H. Strang, S. Nelson Lee, Stephen Lee, A. J. Harvey, Fred H. Ferris and Thomas Slavin, of this village, and W. R. Palmer, of Stillwater.

DETROIT, MICH.—The lighting of Detroit costs $40.16 per arc lamp, according to the financial statement of the commission. This is a reduction of nearly $1 from last year's figures, when each arc lamp cost $41.03. The total cost of operating for the year was $123,093.99, an increase of $2,685.98 over last year, but 143 new lamps have been installed since then. During the year there was spent $199,318.05, leaving a balance on hand of $42,592.75. The amount spent for permanent investment during the year is estimated at $63,903.97, bringing the total investment in the plant up to $849,506.43. Deducting three per cent for depreciation, this makes a total net investment on June 30, 1904, of $824,021.24, giving a total net increase in investment of $36,967.43.

NEW PUBLICATIONS.

MINING MAGAZINE—The first issue of the *Mining Magazine*, a new monthly published by Mr. W. J. Johnston, at 120 Liberty street, New York city, contains several articles of value to the active mine manager, superintendent or engineer. There is an illustrated article by John A. Church, entitled "Mining, Past and Future." Frederick Leslie Ransome contributes an illustrated article entitled "The Geographic Distribution of Metalliferous Ores Within the United States." "Notes on the Metallurgy of Copper, Lead and Zinc" are treated by Walter Renton Ingalls. An illustrated article by Carl Henrich treats of the Guanajuato mining district. Other contributions are: "Commercial Conditions of the Competitive Coal Markets," by Henry S. Fleming; editorials; mining digest and a mining index. The subscription price is $2 a year, $1 additional for foreign postage.

THE CEMENT AGE—The *Cement Age* is a new magazine published by Bruce & Johnston, at 42 Broadway, New York city. The first issue of the *Cement Age* was published in June, 1904. This contained a reprint of a paper read before the Engineers' Club, of Philadelphia, on "The Many Uses of and Increasing Demand for Plastic Materials." The second number, published in July, contains a résumé of the report of the Insurance Engineering Experiment Station on the conflagration in Baltimore. The publishers promise other numbers equally strong, and even better than the initial issues. The editor of the paper is Mr. Robert W. Lesley, who is well known as a broad-gauged and thoroughly experienced architect and engineer. The initial issues of the magazine are entitled, at least, to a careful consideration. The illustrations are well taken care of, and the general appearance and make-up are very good. The charter subscription offers the magazine for a year for fifty cents.

ELECTRIC RAILWAYS.

OTTUMWA, IOWA—A right of way is being secured for the proposed Chicago, Ottumwa & Western Electric interurban. The first portion will be built from this city to Eddyville.

PORTLAND, ORE.—Articles of incorporation are to be filed for the Portland, Salem & West Side Railway. The road will be seventy-one miles long and will be operated by electricity. The estimated cost of the road is $1,000,000.

BOSTON, MASS.—The West End Street Railway Company has petitioned the railroad commissioners for authority to issue 3,000 shares of additional stock, aggregating $150,000 par, for payment of improvements, alterations and permanent additions.

OKLAHOMA CITY, OKLA.—The name of the Metropolitan Street Railway Company has been changed to the Oklahoma City Railway Company, and the new company will at once proceed to construct about five miles more of track. Ten new cars have been ordered.

NIAGARA FALLS, N. Y.—At the next meeting of the legislature application will be made to allow the St. Catharines, Pelham & Welland Electric Railway Company to extend its line through the townships of Pelham, Wainfleet and Moulton to a point within the town of Dunnville.

DARBY, PA.—The council has passed an ordinance granting the Darby & Yeadon Street Railway Company permission to come into the borough. The company, which is a branch of the Philadelphia Rapid Transit, has agreed to pave Main street and other thoroughfares in the borough and pay a license fee of $8 per car.

JACKSON, MICH.—Negotiations are said to have been closed and papers signed for the joint operation of the Detroit, Ypsilanti, Ann Harbor & Jackson line with the Jackson city lines and the branches to Wolf Lake and Grass Lake. This will obviate the building of a second line between Jackson and Detroit by the New York interests owning the Jackson Consolidated Traction Company.

BOULDER, COL.—The Denver & Boulder Interurban Railway Company states that it has secured all the right of way between Louisville and Bloomfield, and most of the right of way between Louisville and Boulder as well as between Bloomfield and Denver. At Denver connection is to be made with the Tramway company and at Boulder with the Boulder Electric Light and Power Company.

WILLIAMSPORT, PA.—Capitalists of Renovo and North Bend are discussing the advisability of constructing a trolley line from Renovo to North Bend. The distance between the two towns is only three miles, and it is thought the enterprise would be a paying one. The plan as outlined is to construct a dam in Young Woman's creek and erect a power-house there. Electricity for light, heat and power will be supplied to Renovo and North Bend.

FOND DU LAC, WIS.—Notice of acceptance of the street railway franchise granted to the Citizens' Light and Power Company, of Milwaukee, last April has been filed. The company filed a bond of $200, as security for the performance of its part of the contract, with the bid, which was an offer of about sixteen per cent of the gross earnings of the company, to be paid the city in consideration of the privileges granted. The company will forfeit this bond if the railway is not built.

DES MOINES, IOWA—Stuart and Madison County people, aided by residents of Greenfield, are interested in the organization of a company for the construction of an electric line from Des Moines to Winterset and thence west to Greenfield. This is the third move for the construction of an electric line through this territory. The promoters of this project propose to utilize the survey of the Des Moines & Southern road, made by Frank W. Cherry of this city, and which was abandoned for a route further south.

WEBB CITY, MO.—There is a move on foot to build an extension of the electric railway which connects this city with Joplin, Carthage, Carterville and Galena, Kan., to Baxter Springs. The project is being backed by the Spring River Power Company, which is to build a mammoth electric plant on Spring river, near Lowell, Kan. Baxter Springs has agreed to furnish the right of way, according to a proposition made them by Samuel Brown, of Chicago, who is representing the Spring River company's interests here. If this extension is made the line will have connections with towns more than thirty-five miles apart. The head offices and electric power plant of the Southwest Missouri Electric Railway Company are in this city.

OKLAHOMA CITY, OKLA.—At the close of a meeting of the directors of the Guthrie, Fairview & Western Railroad announcement was made that the road had secured the money necessary to construct the proposed line, and that the road would be built from Oklahoma City to Fairview *via* Kingfisher at once. It is said that the company has negotiated a loan of $3,500,000 on the proposed line, the first instalment to be paid over to the company when ten miles of the line is completed. The finances are in such shape that the road can be built at once.

MANCHESTER, N. Y.—The Rochester & Eastern Rapid Railway Company has secured a renewal of the franchises granted it two years ago, allowing it to build a road through this section. The proposed new line will be a branch of the one now in operation between Rochester and Canandaigua, and beginning at Victor will extend south through Farmington, touching the villages of Manchester, Shortville, Clifton Springs and Phelps to Oaks Corners, where it will connect with the main branch again. The present prospects are that work will be begun as soon as the ballasting on the main branch is completed.

GOSHEN, IND.—The directors of Winona Assembly, among whom are John D. Rockefeller, H. J. Heinz, John Wanamaker and J. M. Studebaker, announce that they will build and operate an interurban electric railway from Warsaw to Goshen, twenty-five miles, to connect with South Bend, Elkhart, Mishawaka, Niles (Mich.), Laporte, St. Joseph (Mich.) and Benton Harbor (Mich.) lines. The net earnings will go to the Winona Assembly treasury. Dr. Soll C. Dickey, of Indianapolis, representing the assembly, has closed with the Commercial Exchange arrangements for this city to give $30,000 to aid the project. The line will be in operation May 1, 1905, the date of opening the next assembly.

LOCKPORT, N. Y.—Work has been begun on the Buffalo, Rochester & Lockport Electric Railroad. which is to connect Rochester with Lockport, Buffalo, Tonawanda and Niagara Falls. The road was originally incorporated under the name of the Albion Electric Railroad, and was expected to run from Albion to Lockport, but later it was decided to extend the line to Rochester on the east, and to make arrangements with the lines entering Lockport for connecting cars, so that when the line is completed it will be possible to go from Rochester to Buffalo or Niagara Falls with only one change. Throughout its whole length the new line will parallel the Falls road, and it will run on its own right of way, except through the streets of the villages and towns. The places through which it will pass are South Greece, Spencerport, Adams Basin, Brockport, Holley, Fancher, Albion, Eagle Harbor, Knowlesville, Medina, Middleport, Gasport and Lockport. The road will be double tracked and heavily ballasted, so that heavy cars can be run at a high rate of speed.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company, which built the interurban line between New Albany and Jeffersonville, Ind., and is preparing to enter Louisville over the Big Four bridge, at Jeffersonville, is closing arrangements for the construction of the line through southern Indiana. The company expects to have a line from Jeffersonville to Sellersburg and eventually to Seymour, where the line will be met by a line from Indianapolis. From New Albany the company will build lines west to Corydon, north to French Lick and West Baden, and another from Vincennes to Princeton, where it will connect with the line of the Princeton & Evansville Traction Company, which is already in operation. With the completion of the lines contemplated Louisville will be in direct communication by electric lines with Evansville and Indianapolis. It has been given out that work on the lines from New Albany to Corydon will be commenced September 1. The line is twenty miles long. Subsidies have been voted in Franklin and Harrison townships, in Harrison County, amounting to $50,000, and the rights of way have been procured. The company hopes also to be able this summer to commence work on the extension of the lines to French Lick and West Baden and Sellersburg.

NEW INCORPORATIONS.

LINCOLN, NEB.—Citizens' Telephone Company. $10,000.

DENISON, TEX.—The Broken Arrow Telephone Company. $5,000

DES MOINES, IOWA—Afton Mutual Telephone Company. Increased to $25,000.

LANSING, MICH.—Bessemer & Ironwood Interurban Railway Company. $25,000.

ALABASTER, MICH.—Erie & Michigan Railway and Navigation Company. $250,000.

MITCHELLVILLE, IOWA—Mitchellville Telephone Company. Increased to $25,000.

LANSING, MICH.—Battle Creek & Grand Rapids Inland Lakes Traction Company. $520,000.

COLUMBUS, OHIO—The Tipp Interurban Telephone Company. Increased from $10,000 to $30,000.

PATCHOGUE, N. Y.—The Suffolk County Telephone Company. Increased from $3,500 to $13,500.

SHELLSBURG, IOWA—Farmers' Mutual Telephone Company. $10,000. Incorporators: J. D. Hagan and others.

CLARKFIELD, MINN.—The Clarkfield Telephone Company. $3,000. Incorporators: John Larson and nineteen others.

SHEFFIELD, ALA.—The Sheffield Railway. $25,000. Incorporators: George Parsons, J. W. Worthington and Henry Parsons.

LOUISVILLE, KY.—The Randolph & Hiseville Telephone Company. $500. Incorporators: L. B. Strader, J. H. Owen and E. Evans.

DES MOINES, IOWA—Greene Electric Light and Power Company. $10,000. Incorporators: O. C. Perrin, of Greene, and others.

GILLESPIE, ILL.—Gillespie Electric Light Company. $15,000. Incorporators: C. W. Smith, G. W. Schmidt, Jr., Nettie E. Schmidt and E. W. Gillet.

NASHVILLE, TENN.—Sardis Electric Company. $25,000. Incorporators: D. L. Rush, W. R. Roberts, W. H. Harney, L. L. Pearson and R. P. Carey.

FRANKTON, IND.—The Farmers and Citizens' Telephone Company. $10,000. Directors, George F. Quick, Thomas Bromley, Jr., and Ernest H. Phillips.

DESPATCH, N. Y.—Despatch Heat, Light and Power Company. $500,000. Directors: A. H. Bown and W. W. Bown, Penfield, and W. P. Thistlewaite, Macedon.

MONTGOMERY, ALA.—Jasper Water, Light and Power Company. $50,000. Incorporators: J. H. Cranford, L. W. Lollar, E. M. Cranford, D. K. Carter, R. O. Cranford and F. Gavin.

LOUISVILLE, KY.—The Big Leather Wood Telephone Company; $2,500; incorporators, Jesse Morgan and B. P. Wooten, of Hazard. The White Plains & Red Hill Telephone Company; $500; incorporators, W. L. Moore, R. T. Gunn and B. F. Dukes.

LAKE VALLEY, MINN.—The Lake Valley Cooperative Local Telephone Company. To build and operate telephone lines in Lake Valley and fourteen townships and four villages in Traverse County, and in three townships and two villages in Grant County. $10,000. Incorporators: John A. Nonson and others.

LA SALLE, ILL.—Illinois Valley Railway Company. To be constructed from Joliet southwest to Morris, thence west to Marseilles, Ottawa, Utica, La Salle and Peru, thence west to Spring Valley, Ladd and Princeton. $100,000. Incorporators and first board of directors: F. W. Bedard, La Salle; H. E. Chubbuck, V. J. Duncan, A. F. Shoch and C. E. Hook, of Ottawa.

LEGAL NOTES.

SUITS BY THE WESTON ELECTRICAL INSTRUMENT COMPANY—In a suit brought upon patent No. 392,387, dated November 6, 1888, to Edward Weston, Judge Hoyt H. Wheeler, on July 12, 1904, in the United States Circuit Court for the Southern District of New York, granted a motion for a preliminary injunction against the Empire Electrical Instrument Company. On July 20, in the same court, Judge Wheeler granted a motion for a preliminary injunction, in a suit brought upon the same patent against the Whitney Electrical Instrument Company, *et al.*

RIGHT TO SPECIFY RATES—The right to specify the rate of telephone service by a municipality having statutory control of the use of its streets for telephone wires has been sustained in Charles Simon's Sons Company *vs.* Maryland Telephone and Telegraph Company.

ELECTRIC RAILWAY HELD TO BE A TRUNK LINE—An electric railway has been declared to be a trunk railway, being included in a constitutional provision prohibiting municipalities from granting franchises except to the highest bidder, when the road in question is operated between two different cities in different states and is engaged in the carrying of passengers and freight.

AIR BRAKES ON ELECTRIC CARS—In People *vs.* Detroit United Railway it is held that, before a municipal ordinance requiring the equipping of street cars with air brakes shall be declared unconstitutional, it must be made to appear that there is no necessity for a more effective brake than those in use, or that the air brake will not be so.

FINANCING MUNICIPAL LIGHTING PLANTS—It has been decided that the expense of erecting and operating plants for the furnishing of municipal lighting and water is a necessary one and within the meaning of constitutional provisions permitting municipal corporations the right to incur such expenses without submitting the proposition to its voters.

DAMAGES FOR NEGLIGENCE IN THE DELIVERY OF A TELEGRAM—A recent decision fixes the damages recoverable for negligence in the delivery of a telegram, resulting in the loss of a sale of corn at a price above the prevailing market rate, as follows: it provides that the measure of damages shall be the difference in value between the price the corn would have brought had the sale been made, and the market value of the corn at such time and place, although it was finally disposed of at a higher price.

TURN-DOWN LAMP SUIT—The Phelps Company, Detroit, Mich., advises that it has brought suit against five companies because of the sale of "Economy" turn-down lamps, which lamps are alleged to be an infringement on the "Hylo" lamps, patents for which were issued to W. J. Phelps on May 10, 1898, and which patents were claimed to cover the baby filament turn-down lamps. The companies against which suits have been brought are said to be as follows: Barton & Netting, fixture dealers, Detroit; Miller-Selden Electric Company, Detroit; Seidler-Miner Electric Company, Detroit; Electric Appliance Company, Chicago; Monarch Electric Wire and Fixture Company, Chicago; Henry Newgard, Chicago.

SELF-REGULATING TRANSFORMER CASE—In the United States Circuit Court for the Northern District of New York, on June 18, 1904, Judge Coxe granted a motion for a preliminary injunction in favor of the Westinghouse Electric and Manufacturing Company, complainant, *versus* the Montgomery Electric Light and Power Company, defendant. The patent in suit is No. 469,809, granted to William Stanley, Jr., March 1, 1892, for improvements in systems of electrical distribution. The Court holds that the essence of the invention is the length of wire on the primary coil of the transformer, and not the method by which that length is determined; and that a length which gives self-regulation is the length set forth in the Stanley patent, irrespective of the means by which it is determined.

OBITUARY NOTICES.

MR. FRANK E. MORSE, superintendent of the power stations of the Brooklyn Rapid Transit Company, died on July 15 at his home, 1327 Dean street, Brooklyn, N. Y. Mr. Morse had been in the employ of the railroad company for ten years.

MR. JOHN C. MOOREHEAD, assistant to President Underwood of the Erie Railroad, died suddenly at seven o'clock on the morning of July 19, at his home, 321 Amesbury avenue, Cleveland, Ohio. Mr. Moorehead was one of the best-known railroad men in the central west. He was born March 2, 1844, at Moorehead, Pa. He entered the employ of the Lake Shore at the age of eighteen as a despatcher.

In 1888 he became division superintendent of the Erie Railroad, with headquarters at Galion. In 1896 he was made general manager of all the Erie lines west of Salamanca.

MR. ERNEST K. ADAMS died July 21 at Watkins, N. Y. He was thirty-eight years old, and resided at No. 8 East Fifty-second street, New York city. Mr. Adams was a member of the Grolier Club, New England Society, Metropolitan Club, Riding Club, Yale Alumni, American Institute of Electrical Engineers, New York Botanical Gardens and Metropolitan Museum of Art.

DR. A. FLOYD DELAFIELD died at his home in Stamford, Ct., July 18. He was fifty-seven years of age, and had devoted himself to scientific research for a number of years. He was a member of the American Institute of Electrical Engineers, the Columbia University Alumni Association, the Sons of the Revolution, Society of the War of 1812, the Reform and University clubs, and the Military Order of Foreign Wars.

PERSONAL MENTION.

PROFESSOR SIMON NEWCOMB, U. S. N. (retired), has been elected corresponding member of the Berlin Academy of Sciences.

MR. JAMES D. HOUSEMAN has been elected general manager of the St. Louis County Telephone Company, with headquarters at Clayton, Mo. Until recently Mr. Houseman was general manager of the St. Louis, St. Charles & Western Railway Company.

MR. RAY D. LILLIBRIDGE is one of the participants in the St. Louis automobile run which left New York Monday morning of this week. Mr. Lillibridge runs the car known as the White steam touring car, manufactured by the White Sewing Machine Company, of Cleveland, and was accompanied by two friends.

M. AUGUSTE RATEAU has received the degree of doctor of laws from the University of Wisconsin, in recognition of his achievements as a mechanical engineer; as a contributor to the science of flow of fluids; as a distinguished inventor of steam turbine engines, and as an author of standard books in engineering.

MR. LAMAR WHITCHER has been made manager of the Portland office of the New England Telephone and Telegraph Company. He joined the staff of the company in 1901, and during the past winter was inspector, traveling all over New England. Recently he was toll line inspector, covering Maine, New Hampshire, Vermont and Massachusetts.

MR. R. M. JONES, chief engineer and general superintendent of the Pikes Peak Power Company, of Victor, Col., for the past five years, is now free to undertake other consulting engineering propositions, the above company having finished the construction of its hydraulic electrical plant and consolidated with the Pueblo Traction and Lighting Company.

MR. CHARLES A. MOORE, of Manning, Maxwell & Moore, has purchased a new Fiat automobile of forty horse-power, carrying seven persons. This very modern machine is of foreign make, and is represented in this country by Hollander & Tangeman, of New York. The Fiat automobile is said to embody the very latest improvements, and is notable for its extreme simplicity and absence of vibration. Mr. Moore's handsome machine was specially designed for him, and embodies several of his own suggestions.

MR. ISAAC B. CARPENTER, manager of the Pawtucket branch of the Providence Telephone Company, has been promoted to the position of manager of the traffic department of the company's entire system. This is a new office, and Mr. Carpenter will undertake the duties at once. Mr. Carpenter has been in the employ of the company for twenty-two years, and for ten years has been superintendent. Mr. Charles Kenyon, of Providence, who was chief inspector for the company in that city, has been made superintendent.

MR. HENRY FROST WALKER has been elected to the chair of mechanical engineering at the College of Charleston, S. C. Mr. Walker is a graduate of the Worcester Polytechnic Institute, and after graduation followed a four years' apprenticeship in the workshop. After practising his profession for several years he accepted the position of teacher of mechanical engineering and drawing at the Porter Military Academy, a position which he has held up to the present time. He succeeds Mr. P. L. Wormeley, Jr., who has accepted a position with the Department of Agriculture, at Washington.

ELECTRICAL SECURITIES.

A further general advance was scored during the past week, and this in spite of considerable opposition. The continued rise in security values, however, is, in most quarters, considered to be due to purely professional manipulation, and the cry has been from commission houses in general that the investing public is staying out of the market with a most exasperating persistence. In the more successful houses, the evidence has been that trading in large volume has been comparatively brisk, but the small orders have amounted to practically nothing. This is an indication that the market is being upheld solely by those operators who always have some definite interest in it, and who, at every favorable opportunity, place their investments where there is a sure profit practically in sight.

While a few weeks ago it seemed probable that peaceful conditions in the industrial world would be continued throughout the summer, the labor difficulties involved in the meat-packing industry bids fair at the present time to cause considerable unsettlement to a very large number of traders. This is particularly the case in the eastern states, where the great mass of the population is dependent entirely for its meat foods upon the ability of the western packers to supply the demand.

What appeared to be a condition leading up to the involving of at least two other powers in the Russo-Japanese imbroglio by reason of the seizure of British and German merchantmen by the Russian volunteer fleet, has been dissipated by the backing down of Russia and the disavowal of any intent to sanction unlawful proceedings.

The report from the agricultural belt still continues to give promise of a good crop, and is further in contradiction of the reported damage which was done by the storms of several weeks ago.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 23.

New York:	*Closing.*
Brooklyn Rapid Transit	52⅜
Consolidated Gas	194½
General Electric	162
Kings County Electric	194
Manhattan Elevated	151
Metropolitan Street Railway	115⅞
New York & New Jersey Telephone	147
Westinghouse Manufacturing Company	180

The Brooklyn Rapid Transit Company's net earnings for June show an increase of $215,000 over last year.

The consolidated profit and loss account of the General Electric Company, January 31 to May 31, 1904, shows: surplus, January 31, 1904, $7,293,688.75; sales, $12,028,568.42; royalties and sundry profits, $19,753.71; interest, dividends and discount, $172,678.68. Total, $19,514,689.56. Cost of manufacturing and selling, $9,741,302.87; interest on debentures, $25,268.29; dividends paid, $877,334; profit and loss, May 31, 1904, $8,870,784.40. Total, $19,514,689.56. The consolidated balance sheet as of May 31, 1904, shows total assets of $57,172,949.18, and liabilities of $48,302,164.78, leaving a surplus of $8,870,784.40.

Boston:	*Closing.*
American Telephone and Telegraph	132½
Edison Electric Illuminating	248
Massachusetts Electric preferred	73¾
New England Telephone	123
Western Telephone and Telegraph preferred	87

The Western Telephone and Telegraph Company has declared a semi-annual dividend of 2½ per cent on the preferred stock, an increase of ½ per cent. It is payable August 1.

Philadelphia:	*Closing.*
Electric Company of America	8⅞
Electric Storage Battery common	62½
Electric Storage Battery preferred	62½
Philadelphia Electric	6¼
Union Traction	54
United Gas Improvement	86¼

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	143
Metropolitan Elevated preferred	55
National Carbon common	30
National Carbon preferred	103
Union Traction common	4
Union Traction preferred	29

Chicago Edison directors have declared the regular quarterly dividend of 2 per cent, payable August 1.

National Carbon directors have declared the regular preferred dividend of 1¾ per cent, payable August 15. Books close August 5 and reopen August 16.

INDUSTRIAL ITEMS.

THE BRISTOL COMPANY, Waterbury, Ct., has issued catalogue 13, descriptive of Bristol's recording pressure and vacuum gauges. This catalogue, which has been revised to July 1, 1904, cancels all previous catalogues and lists of Bristol's recording pressure and vacuum gauges.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is constantly in receipt of commendatory letters from engineers who make use of the Allen soldering compounds. The company will be pleased to send literature concerning its products and copies of testimonials from satisfied users.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in bulletin 1029 describes and illustrates type "I" direct-current engine type generators. Detailed views of the assembly of these machines are shown, supplemented by a careful description of the design and construction.

THE NATIONAL MACHINE COMPANY, successor to Woodward & Rogers Company, 111-135 Sheldon street, Hartford, Ct., will be pleased to send a series of new catalogues descriptive of its manufacture. This includes machine tools of every description, special confectioners' apparatus and printers' machinery supplies.

THE ELWELL-PARKER ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of electrical machinery, is placing on the market a strong line of standard automobile battery charging machines. The company has been manufacturing dynamo-electric machines for ten years, and have thousands in successful operation.

THE ELMER P. MORRIS COMPANY, 15 Cortlandt street, New York city, has prepared a fine general catalogue descriptive of wrought-iron and steel tubular poles and pole brackets for electric railways, electric lighting, telegraph and telephone service. This company manufactures also a complete line of material used in the construction and operation of electric railways.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY, Meriden, Ct., states that there is a big demand for its new and enlarged No. 8 catalogue. This catalogue describes and illustrates complete telephones and telephone parts. The company has placed upon the market a new type of five-bar telephone, which is equipped with a non-interfering ringing device. This instrument is for service especially on heavily loaded rural lines.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, Pa., is distributing a new booklet descriptive of "I. T. E." circuit-breakers. These instruments afford automatic and instantaneous protection to motors and generators. They are made in all sizes and for every variety of installation. In addition to this booklet the Cutter Company has published a fine series of bulletins and complete catalogues, which will be sent on request.

THE TURBINE ENGINEERING COMPANY has opened a suite of offices at No. 1270 Fisher Building, Chicago, Ill. This company is the selling agent for the DeLaval Steam Turbine Company in Illinois, Indiana, Michigan, Iowa, Missouri, Kansas and Nebraska. Because of the increased volume of business from these states, it has been necessary to establish the Chicago office. The New York office of the Turbine Engineering Company is in the Whitehall Building, Battery Place.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., in its bulletin No. 3058 describes and illustrates automatic-start induction motors for single-phase current. These motors operate on the pure induction principle, and all sizes from one-quarter horse-power to one-half horse-power are constructed to start promptly under full load without assistance or attention. No commutator, brushes or collector rings are employed to bring the motor up to speed or during operation.

THE KNOWLES STEAM WORKS, 114 Liberty street, New York city, is distributing bulletin K-73, describing its recently designed "Express" pump. This pump is of the reciprocating type, and is directly connected to an electric motor without gears or belts, and a 250-gallon pump runs at a speed of 300 revolutions per minute. In a test, the details of which are given, this pump showed an efficiency of ninety-three per cent. Pumps of this type are built in capacities of from 200 to 4,000 gallons per minute, and for heads from 100 to 2,000 feet.

THE DETROIT & BUFFALO STEAMSHIP COMPANY will be pleased to send on application, accompanied by a two-cent stamp, its World's Fair folder. The company is offering a fine lake and rail route to the World's Fair, St. Louis, *via* the D. & B. line. These steamers are among the finest in the fresh-water service. There are parlors with bath, luxurious staterooms, fine saloon service and up-to-date dining-rooms. Mr. A. A. Schantz is the general superintendent and passenger traffic manager, Detroit, Mich.

THE A. L. DYKE AUTOMOBILE SUPPLY COMPANY, 2108 Olive street, St. Louis, Mo., has increased its capital from $25,000 to $40,000. This amount has been paid in. The company has also moved into a new building which is owned by it, situated on Olive, Washington and Walton streets. This building is near King's Highway and Forest Park, and is one of the best locations in St. Louis for the line of business which the company handles. A showroom is being fitted up for the display of automobile supplies, and the rear of the building is devoted to a shop which has been constructed for the manufacture of specialties.

DODGE & DAY, Philadelphia, Pa., has completed the installation of a 340-horse-power "Buckeye" vertical cross-compound engine, direct-connected to two General Electric 100-kilowatt continuous-current compound-wound generators for the Link-Belt Engineering Company. This company is at work on a three-motor electrically operated locomotive crane, to handle beams, angle iron and other heavy structural material, for use in its new storage yard. The company of Dodge & Day, in conjunction with Ballinger & Perrot, architects, is rebuilding and extending the plant of the Victor Talking Machine Company, Camden, N. J. The shops are to be electrically operated and the motor drive used throughout.

JAMES L. ROBERTSON & SONS, 204 Fulton street, New York city, manufacturers of "Eureka" packing, Robertson-Thompson indicators and other steam specialties, started in February last a guessing scheme, offering three prizes of $200, $75 and $25 in gold to the engineers who guessed nearest to the number of admissions to the St. Louis Exposition on July 4. On receipt of the official figures from the secretary of the exposition—179,258—a committee composed of the publishers or managers of five engineering papers examined the records and awarded the prizes to the following persons: Joseph Carson, engineer Pennsylvania Railroad Company, Newark, N. J., who guessed 178,986, first prize; Mason Chilcote, engineer American Sewer Pipe Company, Akron, Ohio, who guessed 179,738, second prize; Albert Schmith, engineer American Multiple Fabric Company, Providence, R. I., who guessed 180,210, third prize.

THE REEVES ENGINE COMPANY, Trenton, N. J., is having set up at its Trenton works a mammoth boring machine, which has been made by the Meadville Vise Company, Meadville, Pa. This is said to be the largest special cylinder boring machine ever set up in the United States, and, when completed, it will accomplish a saving of from three to four hundred per cent in the time consumed in boring cylinders. The apparatus weighs thirty-five tons, and will be used in boring engine cylinders and engine frames. It is capable of boring three or four cylinders at the same time, and covers a floor space of forty-eight by ten feet, operating horizontally. James Barrett was the designer. The Reeves Engine Company is also having installed a special open-side planing machine. This is a tool of special design, and is being built by the Detrick & Harvey Machine Company, of Baltimore, Md. It will be used for planing engine frames in large quantities. The two new tools will complete the equipment of the Reeves Engine Company for the manufacture of the Reeves engine. For the accommodation of the new machinery the company is erecting a new building fifty by fifty feet, which, when finished, will make the entire plant cover 300 feet in length.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JULY 19, 1904.

765,183 Double-combination local spring-jack; J. L. Kise, Weelington, Kan.

765,185 Controlling apparatus for electrically propelled railway vehicles; B. G. Lamme, Pittsburg, Pa.

765,189 Transformer insulation; O. B. Moore, Edgewood Park, Pa.—An insulating corner-piece for coils of electrical apparatus, comprising one or more pieces of insulating material embodying a partially unfolded double-plait, the edges of which extend approximately radially from the corner of the coil.

765,203 Alternating-current electrical-apparatus; C. F. Scott, Pittsburg, Pa.

765,206-207 Brush-holder; R. Siegfried, Pittsburg, Pa.

765,209 Method of operating and controlling electric motors; N. W. Storer, Pittsburg, Pa.

765,212 Electromagnetic block system of control; G. Thompson, Duluth, Minn.

765,213 Memorandum attachment for telephones; R. W. Thompson, Minneapolis, Minn.

765,216 Trolley-guard; W. C. Washburn, Cincinnati, Ohio.

765,228 Coil-retainer for electrical

(Continued on page 44.)

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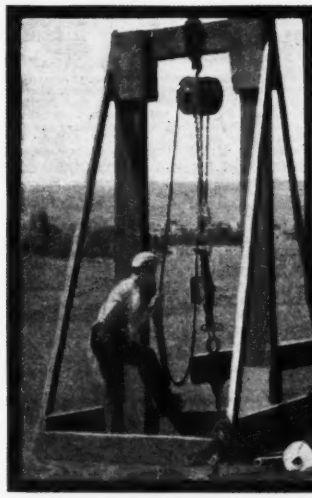

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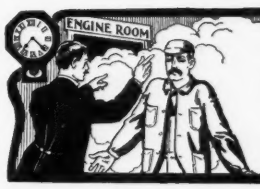

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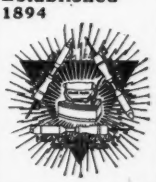

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PATENTS.

(Continued from page 43.)

machines; I. DeKaiser, Wilkinsburg, Pa.

765,236 Controller for electrical transformers; G. E. Gaiffe, Paris, France.

765,255 Service-meter for telephone exchanges; C. E. Scribner, Chicago, Ill.

765,263 Electro fluid-pressure switching mechanism; W. J. Bell, Los Angeles, Cal.

765,264 Railway-crossing signal; W. J. Bell, Los Angeles, Cal.

765,265 Railway-crossing appliance; W. J. Bell, Los Angeles, Cal.

765,266 Audible signaling device; W. J. Bell, Los Angeles, Cal.

765,298 Method of signaling; R. W. Shoemaker, Pasadena, Cal.

765,311 Signal system; S. Friedman, New York, N. Y.

765,329 Block-signal system railways; R. Tomlinson, Brooklyn, N. Y.

765,348 Electric elevator; E. H. Vogel, New York, N. Y.

765,370 Insulated rail-joint; Geo. A. Weber, New York, N. Y.

765,383 Electric secondary clock; F. I. Getty, Chicago, Ill.

765,386 Automatic fire-alarm system; J. C. Howe, Indianapolis, Ind.

765,413 Selective signaling apparatus; J. J. Comer, Parkridge, Ill.

765,435 Alarm device; G. M Mayer, Chicago, Ill

765,441 Device for use with telautographs; F. Ritchie, Hempstead, England.

765,449 Trolley harp; E. R. Warren, Holyoke, Mass.

765,460 Motor-controller; H. H. Cutler, Milwaukee, Wis.

765,461 Selective signaling system; W. M. Davis, Chicago, Ill.

765,465 Method of starting gas or vapor electric devices; S Flichtner, Englewood, N. J.

765,466 Starting system for gas or vapor electric devices; S. E. Flichtner, Englewood, N. J.

765,469 Shade for X-ray tubes; R. Friedlander, Chicago, Ill.

(Continued on page 46.)

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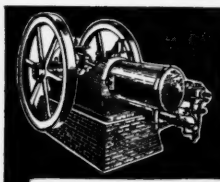

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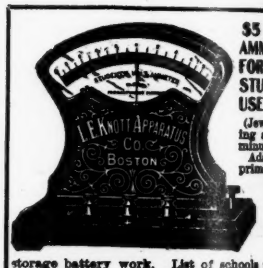

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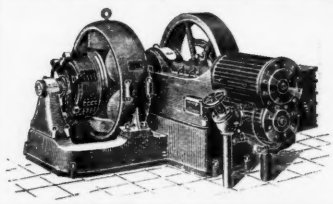

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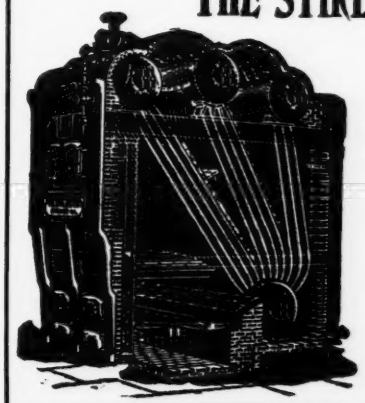

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